

MSC-900 Installation and Maintenance Manual

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Software Version 1.0.x

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FCC CLASS A NOTICE

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void this user's authority to operate this equipment.

NOTE: The MSC-900 has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of the equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

DOC CLASS A NOTICE

This digital apparatus does not exceed Class A limits for radio noise emission for a digital device as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques de la class A prescrites dans le reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

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取扱説明書に従って正しい取り扱いをして下さい。

This equipment is in the Class 1 category (Information Technology Equipment to be used in commercial and/or industrial areas) and conforms to the standards set by the Voluntary Control Council For Interference by Information Technology Equipment aimed at preventing radio interference in commercial and/or industrial areas. Consequently, when used in a residential area or in an adjacent area thereto, radio interference may be caused to radios and TV receivers, etc. Read the instructions for correct handling.

FCC REQUIREMENTS (Notice to Users of DS1 Service)

The following instructions are provided to ensure compliance with the Federal Communications Commission (FCC) Rules, Part 68.

- This device must only be connected to the DS1 network connected behind an FCC Part 68 registered channel service unit. Direct connection is not allowed.
- (2) Before connecting your unit, you must inform the telephone company of the following information:

Port ID	REN/SOC	FIC	USOC
NM-6/DS1C	6.0N	04DU9-BN,	RJ48C
		04DU9-DN,	
NM-2/DS1C	6.0N	04DU9-1ZN, and	RJ48C
		04DU9-1SN	

- (3) If the unit appears to be malfunctioning, it should be disconnected from the telephone lines until you learn if your equipment or the telephone line is the source of the trouble. If your equipment needs repair, it should not be reconnected until it is repaired.
- (4) If the telephone company finds that this equipment is exceeding tolerable parameters, the telephone company can temporarily disconnect service, although they will attempt to give you advance notice if possible.
- (5) Under the FCC Rules, no customer is authorized to repair this equipment. This restriction applies regardless of whether the equipment is in or out of warranty.
- (6) If the telephone company alters their equipment in a manner that will affect use of this device, they must give you advance warning so as to give you the opportunity for uninterrupted service. You will be advised of your right to file a complaint with the FCC.

CANADIAN IC CS-03 COMPLIANCE STATEMENT

NOTICE: The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Industry Canada label does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local tele-communications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

<u>Caution</u>: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

E1 AND E3 NOTICE

The E1 (NM-6/E1C and NM-2/E1C) and E3 (NM-4/E3C and NM-2/E3C) network modules that are described in this manual are approved for use in FORE Systems' host systems providing that the instructions below are strictly observed. Failure to follow these instructions invalidates the approval.

Pan European Approval - CE Marking

Pan European approval of the E1 network module was issued by BABT following assessment against CTR12. This means that it can be connected to ONP and unstructured PTO-provided private circuits with 120 Ω interfaces in all European countries, according to Telecommunications Terminal Equipment (TTE) Directive 91/263/EEC. Thus, the following CE mark applies:

C€168.X

The E1 and E3 network modules conform to safety standard EN60950 1992 following the provisions of Low Voltage Product Safety Directive 73/23/EEC and CE Marking Directive 93/68/EEC, and can be marked accordingly with the CE symbol.

The E1 and E3 network modules conform to EN55022 1994 and EN50082-1 1992 following the provisions of the EMC Directive 89/336/EEC, and can be marked accordingly with the CE symbol.

National Approvals

UK

Network Module	Connects to	Approval Number
E1	Structured and unstructured PTO-provided private circuits with 75 Ω interfaces	AA60953
E3	PTO-provided private circuits with 75 Ω interfaces	NS/4387/1/T/605954

Germany

Network Module	Connects to	Approval Number
E3	Structured PTO-provided private circuits with 75 Ω interfaces	A127535H for the MSC-900

Switzerland

Network Module	Connects to	Approval Number
E1	Structured PTO-provided private circuits with 120 Ω interfaces	96.0872.J.N
E3	Structured PTO-provided private circuits with 75 Ω interfaces	96.0873.J.N

Required User Guide Statements - UK Installation

The use of auxiliary products not authorized by FORE Systems in FORE Systems ATM Switches may cause the power specification to be exceeded and is a potential safety hazard.

The equipment must be installed such that with the exception of the connections to the host, clearance and creepage distances shown in the table below are maintained between the network module and any other assemblies which use or generate a voltage shown in the table below. The larger distance shown in brackets applies where the local environment within the host is subject to conductive pollution or dry non-conductive pollution which could become conductive due to condensation. Failure to maintain these minimum distances invalidates the approval.

Clearance (mm)	Creepage (mm)	Voltage Used or Generated by Host or by Network Modules
2.0	2.4 (3.8)	Up to 50 V _{rms} or V _{dc}
2.6	3.0 (4.8)	Up to 125 V _{rms} or V _{dc}
4.0	5.0 (8.0)	Up to 250 V _{rms} or V _{dc}
4.6	6.4 (10.0)	Up to 300 V _{rms} or V _{dc}

For a host or other expansion card fitted in the host, using or generating voltages greater	Above 300 V_{rms} or V_{dc}
than 300V (rms or dc), advice from a competent telecommunications engineer must be	
obtained before installation of the relevant equipment.	

NOTE: Installing the network modules in the appropriate FORE Systems hosts, according to the installation instructions provided, satisfies the requirements listed above.

The following tables show the available ports and their safety status:

NM-6/E1C and NM-2/E1C

Ports	Safety Status
E1 Ports	TNV operating at SELV
Bus Connector	SELV

NM-4/E3C and NM-2/E3C

Ports	Safety Status
E3 Ports	TNV operating at SELV
Bus Connector	SELV

CE NOTICE

Marking by the symbol **CE** indicates compliance of this system to the EMC (Electromagnetic Compatibility) directive of the European Community and compliance to the Low Voltage (Safety) Directive. Such marking is indicative that this system meets or exceeds the following technical standards:

- EN 55022 "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment."
- EN 50082-1 "Electromagnetic compatibility Generic immunity standard Part 1: Residential, commercial, and light industry."
- IEC 1000-4-2 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 2: Electrostatic discharge requirements."
- IEC 1000-4-3 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 3: Radiate electromagnetic field requirements."
- IEC 1000-4-4 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Electrical fast transient/burst requirements."

SAFETY CERTIFICATIONS

ETL certified to meet Information Technology Equipment safety standards UL 1950, CSA 22.2 No. 950, and EN 60950.

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Preface

This manual provides the technical information needed to install FORE Systems' Multiservice Concentrator 900 (MSC-900), supported LAN and WAN network modules, and the accompanying *ForeThought-SP* software. This document also provides safety instructions, general product information, diagnostic information, and troubleshooting information. This document was created for users with various levels of experience. If you have any questions or problems with the installation, please contact FORE Systems' Technical Support.

Chapter Summaries

Chapter 1 - MSC-900 Hardware - Provides a description of the MSC-900 hardware components.

Chapter 2 - MSC-900 Setup - Provides information for the installation of the MSC-900 and how to verify a successful installation.

Chapter 3 - Hardware Maintenance Procedures - Describes the hot-swap replacement procedures for the concentrator and network modules.

Chapter 4 - Network Module Hardware - Describes network module LED indicators and loopback modes.

Chapter 5 - Software Upgrade Instructions - Describes how to configure a TFTP server, upgrade software, and change between multiple versions of software.

Appendix A - Troubleshooting - Contains basic troubleshooting information for the MSC-900.

Appendix B - SCP Diagnostics - Describes the diagnostic software for the MSC-900's SCP.

Appendix C - Network Module Specifications - Provides cabling, pinout, hardware, and general operating specifications for the MSC-900 and its supported network modules.



A list of ATM networking acronyms and a glossary of terms are provided in the *MSC-900 Network Configuration Manual*.

Technical Support

In the U.S.A., you can contact FORE Systems' Technical Support using any one of the following methods:

1. If you have access to the Internet, you may contact FORE Systems' Technical Support via e-mail at:

support@fore.com

2. You may FAX your questions to "support" at:

412-742-7900

3. You may send questions, via U.S. Mail, to:

FORE Systems, Inc. 1000 FORE Drive Warrendale. PA 15086-7502

4. You may telephone your questions to "support" at:

800-671-FORE (3673) or 412-635-3700

Technical support for non-U.S.A. customers should be handled through your local distributor.

No matter which method is used for support, please be prepared to provide your support contract ID number, the serial number(s) of the product(s), and as much information as possible describing your problem/question.

Typographical Styles

Throughout this manual, all specific commands meant to be entered by the user appear on a separate line in bold typeface. In addition, use of the Enter or Return key is represented as <ENTER>. The following example demonstrates this convention:

cd /usr <ENTER>

File names that appear within the text of this manual are represented in the following style: "...the fore_install program installs this distribution."

Command names that appear within the text of this manual are represented in the following style: "...using the flush-cache command clears the bridge cache."

Subsystem names that appear within the text of this manual are represented in the following style: "...to access the bridge subsystem..."

Parameter names that appear within the text of this manual are represented in the following style: "...using <seg-list> allows you to specify the segments for which you want to display the specified bridge statistics."

Any messages that appear on the screen during software installation and network interface administration are shown in Courier font to distinguish them from the rest of the text as follows:

.... Are all four conditions true?

Important Information Indicators

To call your attention to safety and otherwise important information that must be reviewed to ensure correct and complete installation, as well as to avoid damage to the FORE Systems product or to your system, FORE Systems utilizes the following *WARNING/CAUTION/NOTE* indicators.

WARNING statements contain information that is critical to the safety of the operator and/or the system. Do not proceed beyond a **WARNING** statement until the indicated conditions are fully understood or met. This information could prevent serious injury to the operator, damage to the FORE Systems product, the system, or currently loaded software, and is indicated as follows:

WARNING!



Hazardous voltages are present. To reduce the risk of electrical shock and danger to personal health, follow the instructions carefully.

CAUTION statements contain information that is important for proper installation/operation. Compliance with **CAUTION** statements can prevent possible equipment damage and/or loss of data and are indicated as follows:

CAUTION



You risk damaging your equipment and/or software if you do not follow these instructions.

NOTE statements contain information that has been found important enough to be called to the special attention of the operator and is set off from the text as follows:



If you change the value of the LECS control parameters while the LECS process is running, the new values do not take effect until the LECS process is stopped, and then restarted.

Laser Notice

Class 1 Laser Product: This product conforms to applicable requirements of 21 CFR 1040 at the date of manufacture.

Class 1 lasers are defined as products which do not permit human access to laser radiation in excess of the accessible limits of Class 1 for applicable wavelengths and durations. These lasers are safe under reasonably foreseeable conditions of operation.

Every FORE Systems network module having a fiber optic interface contains a Class 1 laser.



The Laser Notice section only applies to products or components containing Class 1 lasers.

Safety Precautions

For your protection, observe the following safety precautions when setting up equipment:

- Follow all warnings and instructions marked on the equipment.
- Ensure that the voltage and frequency of your power source matches the voltage and frequency inscribed on the equipment's electrical rating label.
- Never push objects of any kind through openings in the equipment. Dangerous
 voltages may be present. Conductive foreign objects could produce a short circuit
 that could cause fire, electric shock, or damage to your equipment.

Modifications to Equipment

Do not make mechanical or electrical modifications to the equipment. FORE Systems, Inc., is not responsible for regulatory compliance of a modified FORE product.

Placement of a FORE Systems Product

CAUTION



To ensure reliable operation of your FORE Systems product and to protect it from overheating, openings in the equipment must not be blocked or covered. A FORE Systems product should never be placed near a radiator or heat register.

Power Cord Connection

WARNING!



FORE Systems products are designed to work with single-phase power systems having a grounded neutral conductor. To reduce the risk of electrical shock, do not plug FORE Systems products into any other type of power system. Contact your facilities manager or a qualified electrician if you are not sure what type of power is supplied to your building.

WARNING!



Your FORE Systems product is shipped with a grounding type (3-wire) power cord. To reduce the risk of electric shock, always plug the cord into a grounded power outlet.

Preface

CHAPTER 1

MSC-900 Hardware

This chapter introduces the Multiservice Concentrator 900 (MSC-900), its hardware and operating specifications, and its individual hardware components.

1.1 Overview

The MSC-900 is a stand-alone, ATM-based port concentration shelf for the aggregation of DSLAM shelves and DS3-ATM access service. The MSC-900 acts as an ATM cross-connect, statistically multiplexing numerous end user traffic streams into a few high-speed ATM uplinks. Network reliability is ensured by the MSC-900 via its use of redundant uplinks to edge switches. If one of the uplinks is non-operational, virtual circuits (VCs) can be re-established on the back-up uplink using soft permanent virtual circuits (SPVCs).

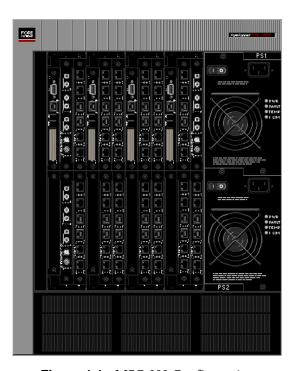


Figure 1.1 - MSC-900 Configuration

Based upon FORE's ATM technology, the MSC-900 operates under *ForeThought-SP* software, is managed by *ForeView* Network Management Software, and is fully compatible with FORE's line of existing network modules. Further, as residential broadband services migrate from PVC-based services to SVC-based services, the MSC-900 can be designed to support numerous UNIs per physical port for cross-connect access to the ATM network.

The MSC-900, as shown in Figure 1.1, is a self-contained concentrator that provides an Ethernet connection for network management access. The hardware for the MSC-900 consists of up to four multiplexer modules, each with an i960 SCP; network modules; redundant power supplies; a Common Equipment Card (CEC); and a removable fan tray. These components work together to provide ATM cross-connect capabilities, as well as distributed connection setup and management.

1.1.1 Access and Uplink Modules

The MSC-900 is designed to concentrate multiple access streams into uplink streams. Therefore, supported network modules are classified as "access" or "uplink," and permitted only in specific multiplexer module slots.

Any supported network module that is slower than 155 Mbps (e.g., DS3, E3, DS1, E1) is considered an access module. Any 155 Mbps or faster network module (e.g., UTP-155, OC-3c, OC-12c) is considered an uplink module.

1.1.2 Uplink Slots

The backplane of the MSC-900 only recognizes uplink modules in certain multiplexer slots. Allowable uplink module locations are slots 1A, 1B, and 4C (as shown in Figure 1.1).



Access modules can be installed in any slot of the MSC-900, with no exceptions.

1.2 MSC-900 Specifications

The MSC-900 has the following specifications:

Features	Specification	
Concentrating Capacity	1.8 Gbps, non-blocking	
Number of Ports	2 to 96 ports	
Traffic Policing	UPC, dual leaky bucket support	
Switch Transit Delay	< 12 microseconds	
Connection Setup Time	< 8 milliseconds, 120 calls/second	
Control Processor	i960 HA control processor	
Maximum Uplink Speed	622 Mbps (OC-12/STM-4c)	
Ethernet Interface	Standard RJ-45 connector	
Serial Interface	DB-9 female connector	
Power (nominal)	100-120VAC @ 50 - 60Hz, 12 amps maximum	
	200-240VAC @ 50 - 60Hz, 6.5 amps maximum	
Dimensions	H: 24.5" (62.2 cm), W: 19" (48.3 cm), D: 18" (45.7 cm)	
Weight	AC: 89.7 lbs (41 kg); DC: 83.1 lbs (38 kg)	
	General Specifications	
Standards Compliance	ITU I.361 ATM Layer, ATM Forum UNI v3.1	
Emissions	FCC Part 15, Class A; CISPR 22, Class A; VCCI Class 1	
Safety	US: UL 1950; Canada: CSA 22.2; No. 950-M89; Europe: EN 60950	
Operating Temperature	5°C to 40°C up to 10,000 ft	
Operating Humidity	10 - 90% relative humidity, non-condensing	
Storage Temperature	-40°C to 70°C up to 30,000 ft	
Storage Humidity	5 to 95% relative humidity, non-condensing	

1.3 MSC-900 Components

1.3.1 Multiplexer Module

The multiplexer module contains the VPI/VCI lookup tables and routing circuitry to ensure that a cell received from an input port is correctly routed to an uplink port. The MSC-900 can be populated with as many as four multiplexer modules. Each multiplexer module can accept up to four network modules, which themselves can contain up to six ports each. The multiplexer module also has an interface, controlled by the SCP, that is functionally equivalent to an ATM host interface.

1.3.2 i960 Control Processor

The MSC-900 utilizes the same i960 SCP as the FORE Systems TNX and *ForeRunner* line of ATM switches. The SCP provides the distributed connection setup for a network of ATM switches. The SCP primarily provides management access through SNMP and is responsible for storing and updating all SNMP management information. Additionally, the SCP has direct access to the multiplexer module. The SCP, and associated software, manages the behavior of the multiplexer module (i.e., connection setup), but is not involved in the actual routing of cells.

1.3.2.1 i960 Features

The front panel of an i960 SCP includes the following features: a RESET button, an RS-232 serial port, an Ethernet 10BaseT port, a NEXT pushbutton, a SELECT pushbutton, a display LED, and a power LED. All of the features are illustrated in Figure 1.2 and are described in detail in the subsections that follow.



Figure 1.2 - i960 Switch Control Processor Front Panel

1.3.2.1.1 RESET Button

The RESET button lets the user reset the software on the SCP. Using RESET "soft boots" the SCP and runs the initial power-on diagnostics. All open AMI sessions are terminated. All ports lose connectivity and initially go off-line after a reset. The ports then return to the configuration stored in the CDB. Because the RESET button is small (to avoid accidental resets), it is recommended that you use a straightened paper clip to push the RESET button.

1.3.2.1.2 RS-232 Serial Port

The RS-232 serial port provides terminal access for any VT100 (or similar) terminal or terminal emulation package. The port has a standard DB-9 female connector as shown in Figure 1.3.

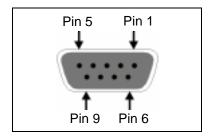


Figure 1.3 - RS-232 Serial Port Pinouts

Table 1.1 describes the RS-232 serial port pinouts that are illustrated in Figure 1.3.

Signal Pin Number Signal Name Mnemonic DCD 1 **Data Carrier Detect** 2 RXD Receive Data 3 **TXD** Transmit Data Data Terminal Ready 4 DTR Signal Ground 5 **GND** Data Set Ready 6 **DSR** 7 RTS Request to Send CTS 8 Clear to Send 9 Not Used

Table 1.1 - RS-232 Serial Port Pinouts

1.3.2.1.3 Ethernet 10BaseT Port

The Ethernet 10BaseT port on the front panel of the SCP has a standard RJ45 connector. There is a transmit LED to the left of this port and a receive LED to the right of this port. Table 1.2 and Table 1.2 describe the states of the LEDs and their meanings.

Table 1.2 - Ethernet 10BaseT Transmit LED Description

LED Color	Meaning
red	There is a collision on the port.
green	The port is transmitting normally.

Table 1.3 - Ethernet 10BaseT Receive LED Description

LED Color	Meaning
red	The port is failing link integrity.
green	The port is receiving normally.

1.3.2.1.4 CTL Port

A control port inside the SCP, referred to in the MSC-900 software as the CTL port, is a logical (not physical) location where cells that are directed to the SCP itself are sent. The CTL port has two roles, serving as both a host and a multiplexer module controller. All signalling from the concentrator and every attached host must interact with the multiplexer module controller.

1.3.2.1.5 NEXT Pushbutton

The NEXT pushbutton lets you scroll through the menu that is shown on the display LED after the power is turned on or after the SCP is reset/rebooted.

1.3.2.1.6 SELECT Pushbutton

The SELECT pushbutton lets you choose an option from the menu that is shown on the display LED after the power is turned on or after the SCP is reset/rebooted.

1.3.2.1.7 Display LED

During the boot process and the initial power-on diagnostics, the display LED shows messages about what is happening to the SCP. It is also used to show the menu choices for the NEXT and SELECT pushbuttons after the power is turned on or after the SCP is reset/rebooted. The choices shown on the display LED are as follows:

Flash? When chosen, the SCP will attempt to boot from the FLASH file.

Ethernet? When chosen, the SCP boots from the network.

Monitor? When chosen, the user can connect a terminal to the serial port and run hardware self-diagnostics.

Auto? When chosen, the SCP will attempt to boot from the FLASH. If this is unsuccessful, then the SCP will perform an Ethernet boot.

To access the modes listed above, press the NEXT pushbutton while the MSC-900 is booting until the mode you want to access is displayed LED. Then, press the SELECT pushbutton.

After the boot process and self-diagnostics are complete, the name of the SCP is shown in the display LED during normal operations, if an SCP name has been assigned. If an SCP name has not been assigned, it will display MSC-900. For information on creating or modifying the SCP name, please refer to the section on configuring the SCP name in the *ForeThought-SP AMI Reference Manual*.

1.3.2.1.8 Power LED

The power LED that is located to the right of the display LED on the front panel of the SCP reflects the current state of power to the SCP. Table 1.2 lists the states of the power LED and their meanings.

Table 1.4 - Power LED Description

LED Color	Meaning
red	The SCP has power, but has failed. (The individual SCP, not the entire MSC-900, has not passed self-diagnostics.)
green	The SCP is powered up and is in good status.
off	There is no power to the SCP.

1.3.3 Dual SCP Setup

This section explains SCP failover support, available when two SCPs are installed in a single MSC-900 multiplexer module. For more information about configuring dual SCP's via AMI, see the *ForeThought-SP AMI Reference Manual*.



Only SCP-ASXHAs, or later, support the dual SCP configuration. Using an earlier version SCP in a redundant configuration can cause irreparable damage to the SCP or MSC-900.

When two SCPs are installed in a multiplexer module, the MSC-900 recognizes their presence and automatically runs in dual SCP mode. When the MSC-900 boots, the SCP which resides below network module slots A and C (slot X) is designated as the primary SCP by default. However, this designation can be altered via AMI. The SCP which resides in the slot below network module slots B and D (slot Y) is designated as the standby SCP by default.

While in dual SCP mode, the controlling SCP emits a "heartbeat" at regular intervals. This heartbeat is monitored by the standby SCP. In the event of a hardware failure on the controlling SCP, the heartbeat disappears and the standby SCP takes over.

Configuration information (i.e., CDB configuration, FLASH configuration, etc.) can be synchronized between the controlling and standby SCP so that this information is maintained if SCP failover occurs.

If a failure is detected on the controlling SCP, the standby SCP takes control of the multiplexer module. At this point, PVC connections are dropped, and any SVCs that had been established are torn down at the MSC-900. Once the standby SCP takes control of the multiplexer module, PVCs will be re-established (according to the "last-synchronized" CDB), and end-stations will signal the MSC-900 to create new SVCs. The larger the CDB (e.g., number of PVCs), the longer the standby SCP will take to fully restore the MSC-900.

The failed SCP can then be removed and replaced with another HA-based SCP.



A standby SCP (SCP-ASXHA or later) can be hot-inserted into the slot from which a failed SCP has been removed.

Repeated and successive hot-insertion or removal of a standby SCP can potentially cause a reset on the primary SCP. This occurrence is intermittent, but will result in cell loss if it does occur.



For proper synchronization of information between SCPs, ensure that the amount of free space on the FLASH of both SCPs is roughly equal before performing these commands.

1.3.3.1 Adding a Standby SCP

If only one SCP is installed in the multiplexer module, it automatically assumes itself to be the controlling SCP. In this case, the SCP periodically checks the multiplexer module for the presence of a second SCP. If a second SCP is detected, the MSC-900 will begin to run in dual SCP mode.

While in dual mode, the controlling SCP continually monitors the presence of the standby SCP. If the controlling SCP fails to detect a second SCP, the controlling SCP disables all synchronization and runs in standalone mode (not dual).

1.3.3.2 Rebooting the Controlling SCP

When the MSC-900 is running in dual mode, a reboot request on the controlling SCP (i.e., after a software upgrade) will not cause the standby SCP to take control of the MSC-900. Instead, the controlling SCP will send a pause signal to the standby SCP.

This pause request will force the standby SCP to disregard the absence of the controlling SCP for two minutes. Once the controlling SCP comes back up, both SCPs will assume normal, dual mode operation.

1.3.3.3 Ethernet Connection

If dual SCP mode is utilized on an MSC-900, the Ethernet connection can be made using the individual SCPs or the Ethernet port on the MSC-900's Common Equipment Card (CEC-Plus).

If the SCP is accessed via ATM, the Ethernet connection is not necessary.



If two SCPs are installed in a multiplexer module, each SCP must have its own entry in the bootptab file (used for network booting). Using only one entry causes unpredictable Ethernet ARP behavior.

1.3.4 Network Modules

The network modules in a multiplexer module act as the physical input/output ports to the MSC-900. A network module may have one, two, four, or six physical ports, depending on its configuration.

1.3.4.1 Port Numbering

The individual ports on a network module are numbered according to the Board-Network Module-Port (BNP) notation.

Refers to the number of the multiplexer module that contains the port being numbered. "Board" can be 1, 2, 3, or 4 in an MSC-900, depending on the number of the physical multiplexer module that contains the

port being numbered.

Network Module Refers to the slot (A, B, C, or D) in the multiplexer

module that contains the port being numbered.

Port Refers to the physical port (1 - 6) being numbered on the individual network module.

a the fourth port on a network module in slot R of mu

For example, according to this notation, the fourth port on a network module in slot B of multiplexer module #2 is port 2B4.

Figure 1.4 illustrates how the ports of various network modules, located in multiplexer module #4 of an MSC-900, for example, would be numbered.

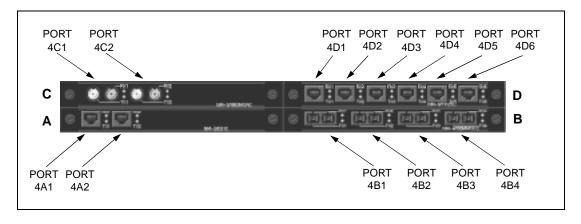


Figure 1.4 - Network Module Port Numbering

1.3.5 Power Supply Modules

The MSC-900 comes with two removable power supply modules, either AC or DC. In the event of a single power supply failure, the power supply indicator LED(s) on the front panel of the supplies will indicate the failed supply. The failed power supply can be removed and replaced while the other supply continues to provide power to the enclosure. In this manner, a single power supply failure will not cause the MSC-900 to stop functioning.

1.3.5.1 MSC-900 AC Power Supply (Model B)

The model B AC power supply for an MSC-900 is shown in Figure 1.5.

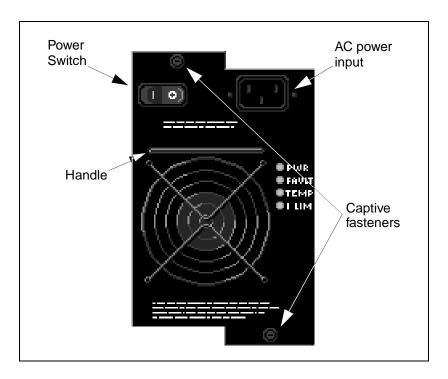


Figure 1.5 - Model B MSC-900 AC Power Supply

1.3.5.1.1 Power Supply LEDs

There are four LEDs on the front panel of the model B MSC-900 AC power supply which indicate the status of the power supply. The LEDs and their functions are described in Table 1.5:

LED	Color	Meaning
PWR OK	Green	Input voltage is OK
I WK OK	extinguished	No input voltage or unit has shut down
FAULT	Yellow	Power supply has faulted
FAULI	extinguished	No faults detected in power supply

Table 1.5 - MSC-900 Power Supply LED Descriptions

Table 1.5 - MSC-900 Power Supply LED Descriptions

LED	Color	Meaning	
TEMP	Yellow	Operating temperature out of range	
	extinguished	Running within safe temperature range	
ILIM	Yellow	Overload condition	
I LIM	extinguished	Load in range	

1.3.5.1.2 Shutdown Conditions

To avoid damaging itself or the MSC-900, the model B MSC-900 AC power supply shuts itself down under the following error conditions:

Input undervoltage The AC line voltage is below 87 ±5VAC RMS.

Output undervoltage Output 1 is 42 ± 2 VDC or Output 2 is below 4.5 ± 0.25

VDC. Shutdown from undervoltage is defeated during power-up period (2 seconds maximum) to

allow slow-start.

Output overvoltage The voltage at Output 1 or Output 2 is above 125%

±8% of the nominal voltage.

Overtemperature Any power semiconductor has reached 90% of its

maximum junction temperature.



The MSC-900 CEC can not shut down the model B power supply. Only the power supply can shut down and restart itself.

If a model B power supply goes into shutdown, it remains turned off until the fault condition is rectified. At that point, the power supply restarts itself, except in the case of an overvoltage condition.

To recover from a shutdown caused by an overvoltage state, the AC line input must be turned off for at least one second.

WARNING!



A replacement AC power supply should never be placed in an MSC-900 that already contains a DC power supply, and vice-versa. If these instructions are not heeded, there is a risk of electrical shock, danger to personal health, and serious damage to the equipment.

If the power supply needs to be replaced, please refer to Chapter 3, Hardware Maintenance Procedures, for hot-swap information.

1.3.5.2 MSC-900 -48 Volt DC Power Supply (PS-1000/DC-B)

Power supply PS-1000/DC-B for an MSC-900 is shown in Figure 1.6.

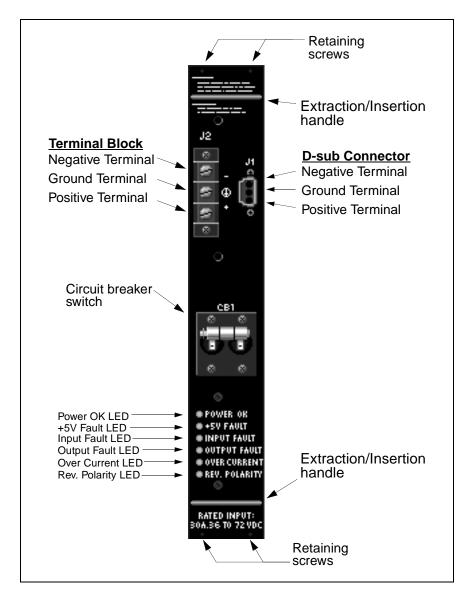


Figure 1.6 - MSC-900 DC Power Supply (PS-1000/DC-B)

On the front panel of power supply PS-1000/DC-B, there is a three-screw terminal block connector and a male, three-pin D-subminiature power connector. Each connector is covered when the power supply is shipped from FORE Systems.



An unused power connector should always be kept covered.

The terminal block screws are #10 screws. The -48V feed wires should be attached to the block using wire terminals designed to fit #10 studs. FORE Systems recommends using either ring terminals or locking forked tongue terminals. Wire gauge should be no smaller than AWG #10 and no larger than AWG #6.

The three-pin D-subminiature connector should be attached to a -48 volt power source with appropriately sized wire utilizing a female, three-pin connector.

CAUTION



Be sure to observe polarity when attaching the wire leads to the terminals.

Each connector (i.e., the terminal block and the 3-pin D-sub) is oriented in the same way: negative terminal on top, ground terminal in the middle, and positive terminal on the bottom.



The DC powered MSC-900 is designed to be connected to a -48V DC power source.

The higher potential wire (Grnd) should be connected to the positive (+) terminal, and the lower potential wire (-48v) to the negative (-) terminal. A third, chassis ground wire should also be connected to the center terminal (\perp) and connected to an earth ground.

PS-1000/DC-B has six LEDs on its front panel. The behavior of these LEDs is described in Table 1.6.

Table 1.6 - LED Behavior

LED	Color	Indicates	Troubleshooting Tips	
Power OK	Green	No faults, voltage and current are OK.	n/a	
	Off	No input voltage, the unit is off, or a fault exists.		
+5V Fault	Red	The power supply (+5V) has faulted.	If no other red LEDs are illuminated, the power supply	
	Off	No +5V fault detected in the power supply.	needs to be replaced.	
Input Fault module is less than 38 volts or greater than 70 volts. the acceptable Disconnect				
			power supply from the feed and troubleshoot the source.	
Output Fault	Red	The power supply's output voltage is less than 38 volts or greater than 70 volts.		
	Off	Output levels are normal		
Overcurrent	Red	The input current is above the operating limit.	The DC source is outside of the acceptable input range.	
	Off	Input current is normal.	Disconnect the MSC-900 power supply from the feed and troubleshoot the source.	
Reverse Polarity	Red	The "+" and "-" feed wires are connected to the wrong (opposite) terminals on the power supply.	Remove power from the feed wires and switch feed wire terminations.	
	Off	Feed wire connections are OK.		



If any of the LEDs on the power supply turn red, the power supply module and power source should be examined. Refer to Table 1.6 for initial troubleshooting information.

It is possible that the voltage being supplied to the module is insufficient, but if the power supply itself is found to be defective, please refer to Chapter 3 for information about hot-swapping a failed supply.

1.3.6 MSC-900 Fan Tray

The MSC-900 comes with a removable fan tray. The speed of each fan is monitored by circuitry in the CEC, and is available via SNMP. In this manner, the failure of any fan can be detected immediately. The fan tray is hot-swappable, and the entire tray may be replaced in the event of single or multiple fan failure. For information about how to hot-swap a fan tray, refer to Chapter 3, "Hardware Maintenance Procedures."

1.3.7 MSC-900 Temperature Sensing

In the MSC-900, a built-in thermal temperature sensor resides on each multiplexer module and reads out the module's local temperature. By default, the MSC-900 software will trigger an alarm at 65°C and will reset the alarm when the temperature drops back down to 60°C or lower. However, the user can configure these alarm and reset thresholds in the software on an individual module via AMI. Please refer to the *ForeThought-SP AMI Reference Manual* for more information about configuring these thresholds. If the temperature of an individual multiplexer module were to reach 75°C, the multiplexer module would shut itself down immediately.

CAUTION



This overtemperature condition is detectable by software, and will trigger an alarm condition which is visible through *ForeView* Network Management. Upon detection of an overtemperature condition, the MSC-900 should be turned off to avoid damage to internal components.

1.3.8 MSC-900 Common Equipment Card

The CEC provided with the MSC-900 is the model B CEC that is used in FORE ATM switches, and it performs the same functions. Because each SCP contains an Ethernet port, a major function of the CEC is to provide a single, unified Ethernet port connection for all of the SCPs. The CEC is also responsible for monitoring the environmental conditions of the MSC-900 and reporting this information to the SCPs. The CEC reports conditions such as malfunctioning fans, overheated power supplies, and an overheated enclosure.

1.3.8.1 CEC Front Panel

The front panel of the MSC-900 CEC includes the following features: alarm relay contacts, CEC status LEDs, and an Ethernet port with four LEDS. These features are illustrated in Figure 1.7. Refer to the following subsections for detailed descriptions of these features.

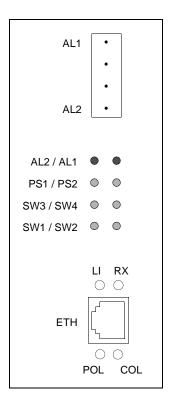


Figure 1.7 - CEC Front Panel Status Indicators

1.3.8.2 Alarm Relay Contacts

Pins 1 and 2 are the contacts for AL1, and pins 3 and 4 are the contacts for AL2. Although the pins are not actually labeled on an MSC-900 CEC, they will be referred to sequentially from top to bottom (i.e., pin 1 is the top pin when the CEC is installed in the MSC-900, and pin 4 is the bottom pin).

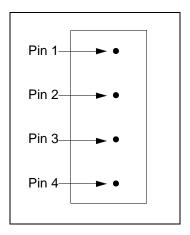


Figure 1.8 - Alarm Relay Contacts for AL1 and AL2

The alarm relay contacts are normally closed when there is no power to the MSC-900. The user can attach alarm circuits to these contacts to trigger an external alarm in the case of an alarm condition on the MSC-900.

The user can define AL1 and AL2 as major and minor alarm indicators and can display which condition is alarming through the use of AMI. For more information, please refer to the alarm configuration section in the *ForeThought SP AMI Reference Manual*.

· · · · · · · · · · · · · · · · · · ·			
Condition	Pins 1 and 2	Pins 3 and 4	
MSC-900 Powered OFF	Jumped	Jumped	
During Boot	Indeterminate	Indeterminate	
Normal Operation	Open	Open	
Minor Alarm Only	Jumped	Open	
Major Alarm Only	Open	Jumped	
Major and Minor Alarms	Jumped	Jumped	

Table 1.7 - Alarm Relay Contact Status During Major and Minor Alarms



In Table 1.7, "Jumped" indicates that the circuit between the indicated pins has been closed (i.e., an external alarm would be triggered if connected to the pins).

1.3.8.3 CEC Status LEDs

This subsection discusses the meaning of the status LEDs on the CEC of the MSC-900. The LEDs have been designed to provide information about the state of the MSC-900 at a glance.

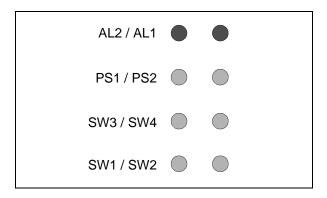


Figure 1.9 - CEC Status LEDs

There are eight status LEDs located on the front panel of the CEC in a 2 x 4 arrangement. The LEDs are broken down into the following function groups: alarm LEDs, power supply LEDs, and multiplexer module LEDs.

1.3.8.3.1 Alarm LEDs

The LEDs labeled AL1 and AL2 are alarm relay LEDs. During boot-up, AL1 and AL2 are in an indeterminate state. During normal operation, they will be off. During a state of alarm, they will illuminate red. By default, AL1 is the major alarm indicator for fan failure, an overtemperature condition, or a power supply failure. By default, AL2 is the minor alarm indicator for SPANS failure and for link failure. The user may display and/or change these configurations through the use of AMI. For more information, please refer to the *ForeThought SP AMI Reference Manual*.

1.3.8.3.2 Power Supply LEDs

There are two power supply LEDs on the front panel of the CEC, one for each power supply. The LEDs for the two power supplies should be illuminated yellow, indicating that the CEC is on and that the power supply corresponding to that LED is functioning correctly. The LED for a failed power supply will be extinguished. On an MSC-900, power supply "1" is in the slot labeled PS1 on the enclosure, while power supply "2" is in the slot labeled PS2 on the enclosure.

1.3.8.3.3 Multiplexer Module LEDs

There are four multiplexer module LEDs on the front panel of the CEC, one for each possible multiplexer module. These LEDs should be blinking, indicating that the MSC-900 has booted and is operating correctly. If the SCP is removed, the LEDs may remain in a steady-on or steady-off state. If the multiplexer module in the slot corresponding to the LED is not intended for an MSC-900 (e.g., it is a TNX-1100 switch fabric), or if the entire multiplexer module corresponding to that LED is removed, then that LED will be extinguished. On an MSC-900, the SW1 LED corresponds to multiplexer module "1," which is in the slot labeled 1 on the enclosure, and so on.

1.3.8.4 Ethernet Port

The Ethernet port located on the CEC of the MSC-900 has a standard RJ-45 female connector and is designed to provide a single, unified Ethernet connection. It is connected via the backplane and simple Ethernet repeater to each SCP's Ethernet port, thus eliminating the need to attach each SCP individually. This Ethernet port has four LEDs which indicate its current status as shown in Figure 1.10. These LEDs are described in Tables 1.8 through 1.11.

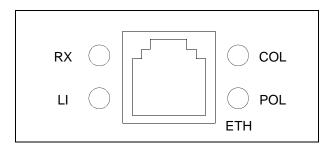


Figure 1.10 - CEC Ethernet Port and LEDs



The Ethernet port on the model B CEC is rotated 180 degrees, but the Ethernet port LEDs are in the same relative location as above.

Table 1.8 - CEC Receive (RX) LED Description

LED Color	Meaning
green	The Ethernet port is receiving traffic normally.
off	The Ethernet port is NOT receiving traffic.

Table 1.9 - CEC Link Integrity (LI) LED Description

LED Color	Meaning
green	The status of the twisted pair cable connected to the CEC Ethernet port is OK.
off	The Ethernet port is NOT receiving link integrity pulses. Check the integrity of the connection.

Table 1.10 - CEC Collision (COL) LED Description

LED Color	Meaning
red	An Ethernet collision has been detected on the CEC Ethernet port.
off	No Ethernet collisions have been detected.

Table 1.11 - CEC Polarity (POL) LED Description

LED Color	Meaning
amber	A reverse polarity condition has been detected on the twisted pair cable connected to the CEC Ethernet port. The polarity is automatically corrected, but the amber light will remain illuminated until a corrected twisted pair cable is inserted into the Ethernet port.
off	The polarity of the twisted pair cable connected to the CEC Ethernet port is OK.

CHAPTER 2

MSC-900 Setup

This chapter contains the following information about setting up the MSC-900:

- Section 2.1 Introduction
- Section 2.2 Unpacking
- Section 2.3 Electrical Considerations
- Section 2.4 Installing an MSC-900
- Section 2.5 Modem Configuration
- Section 2.6 Configuring IP Addresses
- Section 2.7 Post-installation Procedures

2.1 Introduction

Before installing the MSC-900, there are several important factors that must be taken into consideration, depending on the type of installation site. The following sections discuss in detail how to install the MSC-900 and any prerequisites to the installation.



It is important to read through the ENTIRE installation procedure before attempting to turn on the power to the unit.

2.2 Unpacking

Upon receipt of, and before opening your MSC-900, inspect the package for any damage that may have occurred during shipping. If the package shows any signs of external damage or rough handling, notify your carrier's representative.

When unpacking your MSC-900, be sure to keep all original packing materials. They may be needed for storing, transporting, or returning the product.

CAUTION



All products returned to FORE Systems, under warranty, must be packed in their original packing materials.

2.2.1 Inventorying the Unit

An inventory of the MSC-900 package should be performed before supplying power to the unit. The MSC-900 package should contain the following:

- MSC-900
- MSC-900 Installation and Maintenance Manual (this manual)
- MSC-900 Network Configuration Manual
- ForeThought-SP AMI Reference Manual
- 2 Power cords
- Modem serial cable
- Anti-static grounding strap
- Product registration card

If any of the items listed above are missing or damaged, please contact FORE Systems' Technical Support immediately.

2.3 Electrical Considerations

The following items should be considered when setting up the MSC-900:

CAUTION



Consideration should be given to the connection of the equipment to the supply circuit and the effect that the overloading of circuits could have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.

CAUTION



Reliable grounding of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch (i.e., use of power strips).

2.4 Installing an MSC-900

The MSC-900 is designed to be rack-mounted. After mounting the unit, a terminal should be attached and connections to the power source should be made. The following precautions should be addressed when installing the MSC-900:

WARNING!



When rack-mounting equipment, make sure that a hazardous condition is not created due to uneven weight distribution.

CAUTION



FORE Systems recommends that the maximum operating temperature not exceed 40°C. Consideration must be made if the MSC-900 is to be installed in a closed or multi-unit rack assembly, because the ambient temperature of the rack environment may be greater than the room ambient temperature.

CAUTION



Take care not to block the air vents of the MSC-900, as this would compromise the amount of air flow required for proper cooling.

CAUTION



Ensure that any unpopulated multiplexer module slots are covered with a blank panel before turning on your MSC-900. Operating the MSC-900 with any of these slots left open can cause a significant temperature rise in a very short time.

2.4.1 Rack-mounting the MSC-900

To install the MSC-900 in the equipment rack, follow the steps listed below:

1. Choose a rack position for the MSC-900.

WARNING!



Because of the unit's weight, two people should lift the unit to place it in the equipment rack.

2. Place the MSC-900 in the rack with the front of the unit facing forward.

CAUTION



When it is mounted in the equipment rack, do not use the MSC-900 chassis to support other equipment. This could overload the mounting brackets and cause damage to the unit.

3. After mounting the enclosure, verify that the enclosure is screwed tightly to the rack to ensure that proper grounding is maintained. Additionally, the rack should be connected to an earth ground.

2.4.2 Connecting a Terminal

Before turning on the MSC-900, a terminal should be connected for monitoring power-up behavior and performing initial configurations (e.g., IP and Ethernet interfaces). These configurations are necessary on each installed control processor.

Connect the serial cable (supplied with the MSC-900) from the serial port of the MSC-900's control processor to any tty-type device (such as a terminal, or the serial port of a workstation or PC running a terminal emulation program).



The MSC-900's serial port comes configured at 9600 baud, 8 bits, no parity and 1 stop bit.

2.4.3 Connecting the MSC-900 to a Power Source

After mounting the MSC-900, it must be connected to a power source (AC or DC).

2.4.3.1 Connecting to AC Power

For an AC-powered MSC-900, the steps below should be followed when connecting the unit to a power source:

- 1. Ensure that the power switch on both power supplies is in the OFF position.
- 2. Connect the female end of one of the supplied power cords to the AC power input connector on each power supply.
- 3. Plug the male end of each power cord into an approved electrical outlet (110 volt).

2.4.3.2 Connecting to DC Power



The DC powered MSC-900 is designed to be connected to a -48V DC power source.

For a DC-powered MSC-900, the steps below should be followed when connecting the unit to a power source:

- 1. Ensure that the circuit breaker on both power supplies is in the OFF (down) position.
- 2. Remove the protective cover from the power connectors on the front of each power supply.
- 3. If using an intermediate or power conditioning device (e.g., a breaker interface panel), ensure that power is removed from all outgoing power connectors.
- 4. If you are using the three-pin D-subminiature connector, connect one end of the wiring assembly to the power source and insert the other end into the male connector on the power supply.
- 5. Secure the three-pin plug with the screws on the top and bottom of the connector.
- 6. Repeat steps 4 and 5 for each power supply.
- 7. If you are using the three-wire terminal block, connect the feed wires to the DC source and secure the feed wires to the terminal strip on the front of the power supply.



Ensure that the DC feed wires are #6-#10 AWG. The screw terminals are #10 screws. The 48-volt feed wires should be attached to the terminal strips using wire terminals designed to fit #10 studs. FORE Systems recommends the use of either ring terminals or locking forked tongue terminals.

CAUTION

Be sure to observe polarity in the following step.



- 8. The higher potential wire (Grnd) should be connected to the positive (+) terminal, and the lower potential wire (-48v) to the negative (-) terminal. A third, chassis ground wire should also be connected to the center terminal (\downarrow) and connected to an earth ground.
- 9. Repeat steps 7 and 8 for each power supply.
- 10. Once the feed wires have been connected, replace the protective cover on the terminal block.
- 11. Return DC power to the feed wires coming into the supply.

2.4.4 Turning on the MSC-900

After being securely rack-mounted, attached to a terminal, and properly connected to a reliable and safe power source, the MSC-900 is ready to be turned on. To turn on an AC-powered MSC-900, flip the power switch on both power supplies to the ON position. To turn on a DC-powered MSC-900, flip the circuit breaker on both power supplies to the ON (up) position.

After turning on the MSC-900, you should see it boot on the attached tty device.



The MSC-900 is ready for user configuration as soon as it boots. To access the MSC-900, enter ami at the prompt of the tty device.



The MSC-900 is operational at this point if used with other FORE equipment (i.e., switches or interface cards). However, if other vendor equipment is connected, you may have to complete an initial user configuration.



If you wish to have remote access to the MSC-900, you must first connect and configure a modem. Please refer to Section 2.5 for more information.

2.5 Modem Configuration

The MSC-900 supports modem access. This may be useful if it is installed in a remote location where direct, physical access is not possible or practical. Keep the following in mind when using a modem to access an MSC-900:

- To allow the MSC-900 to communicate with the modem, a Null-Modem Adapter must be installed on the factory-supplied serial cable.
- The MSC-900 will not disconnect an ATM Management Interface (AMI) session on loss-of-carrier; therefore, you must ensure that you have completely exited from an open AMI session before disconnecting the modem session.

To allow a modem to work with an MSC-900, the modem parameters must be configured correctly.



The MSC-900 only supports a modem speed of 9600 baud.

2.5.1 Modem Parameters

You should use a Hayes-compatible modem, as the configuration parameters supplied here are applicable to this type of modem. The following parameters should be applied to your Hayes-compatible modem to allow it to function properly with the MSC-900's serial port. You may attach a tty device to the modem to set these parameters.

Setting	Comment
ATE0	Turn off Echoing
ATQ1	No Return Codes
AT&C0	Force Carrier Detect (CD) High
AT&D0	Ignore Data Terminal Ready (DTR)
AT&W	Save Modem Configuration

2.6 Configuring IP Addresses

The recommended configuration for an MSC-900 is to assign an IP address to its network interfaces. This allows you to communicate with the MSC-900 from any workstation connected to your ATM LAN. IP addresses must be assigned to the network interfaces in order to perform any SNMP functions. Additionally, if you intend to connect the MSC-900 to an Ethernet, you should assign an IP address to the MSC-900's Ethernet network interface.

To configure the IP addresses, log in to an AMI session on the MSC-900. To modify the IP address of the SCP's IP interfaces, enter the following parameters:



On an MSC-900, the IP address must be configured individually for each SCP.

configuration ip address <interface> <address>

The *<interface>* variable indicates the name of the IP interface to be managed. The *<address>* variable indicates the IP address for this interface.

To modify the IP subnet mask, enter the following parameters:

configuration ip mask <interface> <mask>

The *<interface>* variable indicates the name of the IP interface. The *<mask>* variable indicates the subnet mask for this IP interface.

The IP address that you assign for the MSC-900's ATM interface must be an address within a subnet that is assigned to your ATM LAN. In general, the entire ATM LAN should be configured as a single IP subnet. Consequently, the ATM interfaces of all MSC-900s in the ATM LAN should be in the same IP subnet. Consult your systems administrator for help if you are unsure of how to do so.

2.6.1 Subsequent Operation

After its initial configuration is complete, an MSC-900 *DOES NOT* require a terminal for normal operation.



FORE Systems strongly recommends that you disconnect the serial cable once you have configured the MSC-900 and then access the unit over the ATM network or over Ethernet.

All further communication with your MSC-900 can be performed over the ATM network or over Ethernet. For example, you can access AMI using telnet.

WARNING!



Once installed, before any service is performed on the unit, the power should be turned off and the power cord disconnected, except when following the hot-swap instructions in this manual.

2.7 Post-installation Procedures

After finishing the installation of the MSC-900, consider the operations listed in this section.

2.7.1 Verifying the Installation

To verify that the MSC-900 is working properly, open an AMI session on the terminal attached to the MSC-900. Enter the following parameters at the localhost::> prompt to show the configuration of all installed ports:

configuration port show

2.7.2 AMI Security

The administrative password on your MSC-900 may be changed to provide password-protected access to AMI. FORE Systems recommends that you do this to prevent unauthorized users from accessing your MSC-900. This option is available in AMI at the operation level. Be sure that you want to change the password because upon entering the command string operation password, the user is prompted to enter a new password immediately.

For complete information about how to assign or change the password, please refer to the *ForeThought-SP AMI Reference Manual*.

2.7.3 Product Registration Information

After you have successfully completed the installation process, please fill out the enclosed product registration card for your MSC-900, and return it to FORE Systems immediately.

CHAPTER 3

Hardware Maintenance Procedures

This chapter discusses various hardware maintenance procedures for the MSC-900. Items discussed include the following:

- Section 3.1 Network Module Replacement
- **Section 3.2** Power Supply Module Replacement
- Section 3.3 MSC-900 Fan Tray Replacement
- Section 3.4 Switch Control Processor Replacement
- Section 3.5 Multiplexer Module Replacement

3.1 Network Module Replacement

3.1.1 Overview

The network modules in the MSC-900 are hot-swappable, meaning that they can be removed and replaced with the unit under power. Network modules should only be hot-swapped for purposes of replacing a failed unit. Therefore, they should be replaced with a network module of the same type, the same Series, and with the same number of ports. A network module's type is the class to which the network module belongs (e.g., DS1, OC-3, E3, TAXI, etc.).

If a network module is removed and replaced by a network module of another type or by a network module with fewer ports, all configuration information for that network module's slot will be deleted, and the new network module will be configured with the defaults for its type. For example, if a 4-port Series A OC-3c is replaced by a 4-port Series C OC-3c, the Series C network module will use the same configuration of the Series A network module. Any additional configurable variables will contain OC-3c defaults. If a 4-port OC-3c is replaced by a 4-port DS1, all configuration information for that slot will be deleted and the DS1 will be initialized with DS1 defaults. If a 6-port DS1 is replaced by a 2-port DS1, all configuration information for the slot will be deleted, and the new DS1 initialized with DS1 defaults. If a network module is placed into a previously vacant slot, it will be initialized into the default state appropriate to that type of network module.

Additionally, "uplink" network modules are only permitted in slots 1A, 1B, and 4C of the MSC-900 (see Section 1.1.1 and Section 1.1.2 for more information).

3.1.2 Multicast Mode

When hot-inserting or hot-swapping a network module, the mode in which the MSC-900 is running must also be considered. An MSC-900 can operate in one of two multicast modes: extended mode or non-extended mode.

- Extended mode The added features of Series C network modules give the MSC-900 greater flexibility when choosing VCIs for multicast connections. This flexibility provides more successful multicast (point-to-multipoint, or PMP) connection setups. If a multiplexer module is empty or if it contains <u>only</u> Series C or Series LC network modules, the MSC-900 will operate in extended mode.
- Non-extended mode If a multiplexer module contains at least one Series A or B network module, that module will operate in non-extended (or mixed) mode.



Series A and B network modules can not operate in the same multiplexer module as Series LC network modules.



The mode in which a multiplexer module operates is determined each time the SCP restarts. If a module is running in extended mode and a Series A or B network module is hotinserted, the module will not automatically revert to non-extended mode. The MSC-900 must be restarted immediately so that it operates in non-extended mode. If it is not restarted, all multicast connections fail on the Series A or B network module.

You can display the multicast mode in which your MSC-900 is operating by using the configuration board show command in the ATM Management Interface (AMI).



If an MSC-900 is running in non-extended mode, originating path 0 should always exist on port 1 of each Series C network module for multicast connection setups to succeed. Multicast connection information for all of the ports of Series C network modules is stored in the space allocated for port 1 and path 0 on each Series C network module.

3.1.3 Hot-swapping Network Modules

When removing or replacing network modules, use the following procedure:

WARNING!



To reduce risk to the user and to prevent damage to equipment, it is recommended that you use the included grounding strap when handling this or any other component.



All AMI sessions should be terminated before swapping network modules of different types.

- 1. Label and remove all network connections from the ports on the network module.
- 2. Loosen the two captive fasteners on either edge of the network module using a straight screwdriver.
- 3. Pull firmly but carefully on the captive fasteners, removing the network module from the MSC-900 as shown in Figure 3.1.

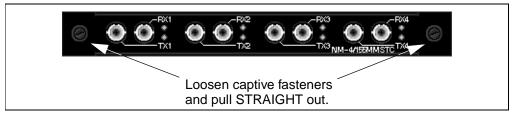


Figure 3.1 - Removal of Network Modules

4. Insert the replacement module by sliding it into the card guides. Push firmly to seat the network module so that the faceplate is flush with the multiplexer module. Retighten the captive fasteners.

CAUTION



To ensure safety, tighten the captive fasteners with a straight screwdriver.

5. Restore the network connections from Step 1.

3.2 Power Supply Module Replacement

The power supplies in the MSC-900 are hot-swappable, meaning that they can be removed/replaced without having to shut down the MSC-900.

WARNING!



DO NOT attempt to replace a power supply module without reading this section. Serious injury to the user or damage to the equipment may result if proper replacement procedures are not followed.

3.2.1 MSC-900 Power Supply Module Replacement

3.2.1.1 Replacing an MSC-900 AC Power Supply

An AC power supply module for an MSC-900 is shown in Figure 3.2.

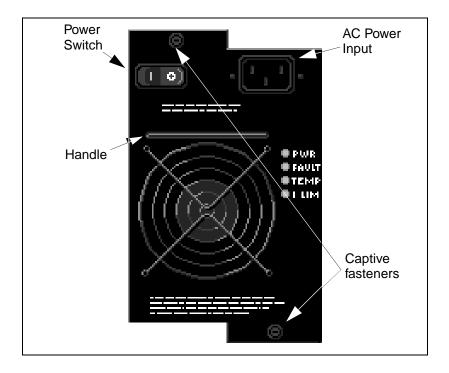


Figure 3.2 - MSC-900 AC Power Supply

The procedure for replacing an MSC-900 AC power supply module is as follows:

WARNING!



A replacement DC power supply should never be placed in an MSC-900 that already contains an AC power supply, and vice-versa. If these instructions are not heeded, there is a risk of electrical shock, danger to personal health, and serious damage to the equipment.

WARNING!



It is highly recommended that you use the included grounding strap when handling this or any other component.

1. Determine which power supply is defective by either consulting *ForeView* to tell which is the bad supply or by examining the power supplies themselves. An extinguished "PWR OK" LED or an illuminated "FAULT" LED indicates the failed supply. On an MSC-900, power supply "1" is in the slot labeled PS1 on the chassis (top), while power supply "2" is in the slot labeled PS2 on the chassis (bottom).

WARNING!



Failure to perform Step 2 can result in serious injury to the user or damage to the equipment.

- 2. Turn OFF the power switch on the front of the defective power supply. Wait at least one (1) second after turning off the power before moving on to the next step.
- 3. Disconnect the AC line from the front of the defective power supply.
- 4. Unscrew the two captive fasteners (one on the upper, left corner of the faceplate and one on the lower, right corner of the faceplate, see Figure 3.2) using a straight blade screwdriver.
- 5. Pull forward on the power supply's handle (located below the power switch and AC plug) to remove it from the chassis.
- 6. Set the failed supply aside and prepare to install the new one.

WARNING!



Failure to perform Steps 7 or 8 can result in serious injury to the user or damage to the equipment.

- 7. Ensure that the power switch on the new AC power supply is turned OFF before inserting the supply into the metal enclosure.
- 8. Check to see that the fuses on the new unit are rated at 15A, 250V.
- 9. Set the supply on the guide rails in the enclosure so that the supply is properly aligned in the slot. Position the supply so that the rear connectors are on top.
- 10. Once the rails are properly aligned, push on the handle on the front of the supply to slide it back into the chassis. Press firmly to ensure that the connectors on the rear of the supply have mated with those on the backplane.
- 11. To ensure maximum safety and to ensure that the connectors have mated properly, tighten the two captive fasteners on the front of the supply using a straight blade screwdriver.
- 12. Once completely installed, you may reconnect the AC line and turn the power switch to the ON position.
- 13. After a second or two, the PWR OK LED on each supply illuminates green, indicating that the supply is functioning properly.

3.2.1.2 Replacing an MSC-900 DC Power Supply (PS-1000/DC-B)

The MSC-900 DC power supply is shown in Figure 3.3.

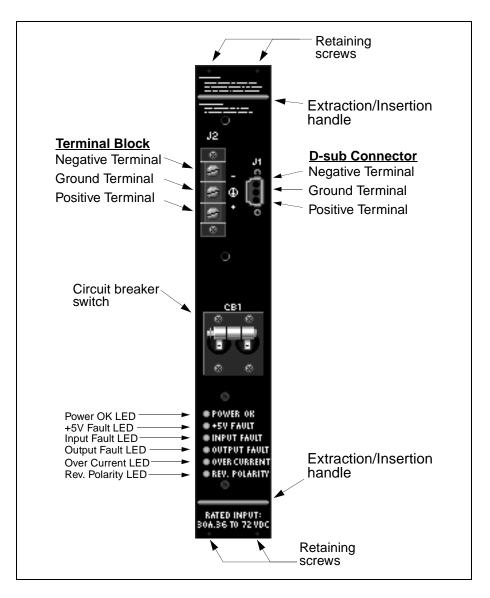


Figure 3.3 - MSC-900 DC Power Supply

The following procedure describes how to safely replace a DC power supply in an MSC-900 that is under power. The switch will operate properly with one power supply while the failed supply or power source is replaced or repaired.



You will need a spare DC power supply (PS-1000/DC-B) and an allen wrench to complete the following procedure.

WARNING!



A replacement DC power supply should never be placed in an MSC-900 that already contains an AC power supply, and vice-versa. If these instructions are not heeded, there is a risk of electrical shock, danger to personal health, and serious damage to the equipment.

1. Determine which power supply is defective by examining the power supply LEDs, either locally or via *ForeView*.



A +5V Fault, Overcurrent condition, or Output Fault (while Input Fault is not illuminated) constitutes a power supply failure. Refer to Table 1.6 in Chapter 1 for initial troubleshooting information.

Power supply "1" is in the slot labeled PS1 on the chassis, and power supply "2" is in the slot labeled PS2 on the chassis.

WARNING!



Failure to perform Step 2 or Step 3 can result in serious injury to the user or damage to the equipment.

- 2. Turn OFF (down) the circuit breaker switch on the failed power supply.
- 3. Shut off DC power to the feed wires of the failed supply. Typically, each MSC-900 resides in its own circuit on a Breaker Interface Panel (BIP). Turning off the top circuit breaker on the BIP removes DC power to the feed wires.

- 4. If you are using the three-pin D-subminiature connector, remove the female connector (leading to the power source) from the male connector on the power supply and proceed to Step 7, otherwise proceed to Step 5.
- 5. Remove the protective plastic cover from the terminal block, exposing the DC feed wires.
- 6. Remove the feed wires from the front of the unit.
- 7. Remove the four retaining screws that secure the power supply in the chassis using a 3/32-inch Allen wrench.
- 8. Pull forward on the ejection/insertion handles to remove the failed supply.

WARNING!



Failure to perform Step 9 can result in serious injury to the user or damage to the equipment.

- 9. Ensure that the circuit breaker switch on the new power supply is turned OFF (down) before inserting it into the enclosure.
- 10. Carefully align the guide rails on the new DC power supply in the slot, then push on the ejection/insertion handles to slide it into the enclosure.
- 11. To ensure maximum safety and to ensure that the connectors have been seated properly, re-tighten the four retaining screws using a 3/32-inch Allen wrench.
- 12. Once completely installed, reconnect the power supply to the dry -48 volt DC feed wires that were removed in Step 4 or Step 6.
- 13. If you are using the three-pin D-subminiature connector, insert the female connector (leading to the power source) into the male connector on the power supply and secure it using the screws on the top and bottom of the connector. You may proceed to Step 16.

tardware Maintenance Procedures

CAUTION

Be sure to observe polarity in the following step.





The DC powered MSC-900 is designed to be connected to a -48V DC power source.

- 14. If you are using the three-wire terminal block, secure the feed wires to the terminal strip on the front of the unit. Ensure that the DC feed wires are #6-#10 AWG. The screw terminals are #10 screws. The 48-volt feed wires should be attached to the terminal strips using wire terminals designed to fit #10 studs. FORE Systems recommends the use of either ring terminals or locking forked tongue terminals.
 - The higher potential wire (Grnd) should be connected to the positive (+) terminal, and the lower potential wire (-48v) to the negative (-) terminal. A third, chassis ground wire should also be connected to the center terminal ($\underline{\bot}$) and connected to an earth ground.
- 15. Once the feed wires have been connected, replace the protective cover on the terminal block.
- 16. Return DC power to the feed wires coming into the supply by turning on the top breaker on the BIP.
- 17. Turn the circuit breaker switch on the front of the new supply to the ON (up) position.
- 18. Ensure that the green "Power OK" LED on the new supply is illuminated. If not, troubleshoot the problem using Table 1.6 in Chapter 1.



If you have any questions about or problems, please contact FORE Systems Technical Support as described in the Preface of this manual.

3.3 MSC-900 Fan Tray Replacement

The MSC-900 has a removable fan tray with large fans that cool the MSC-900 hardware and power supply modules. Located at the base of the upright unit, the fan tray is removable from the front of the unit and is hot-swappable, meaning that it can be replaced with the MSC-900 under power. The procedure for replacing a fan tray is as follows:

WARNING!



It is highly recommended that you use the included grounding strap when handling this, or any other component.

- 1. Remove the four retaining screws at the top of the fan tray with a 3/32-inch Allen wrench.
- 2. Remove the fan tray by pulling it away from the MSC-900 unit.
- 3. Set the old fan tray aside and place the new fan tray in front of the vacant slot in the MSC-900.
- 4. Insert a new fan tray in the slot and slide it all the way into the chassis. Seat the connectors by pressing firmly on the unit (this will apply power to the fan tray).
- 5. Once seated, replace the four screws removed in Step 1 above. This will properly secure the unit in the chassis.

CAUTION



Do not run the unit for any great length of time without the fan tray installed or the unit will shut itself down because of an overtemperature condition.

3.4 Switch Control Processor Replacement

The following procedure explains how to remove an HA-based i960 switch control processor (SCP) from a multiplexer module and install a new one.

WARNING!



It is highly recommended that you use the included grounding strap when handling this or any other component.

CAUTION



Do not attempt to remove or replace an SCP without first removing all connections to the SCP (i.e., serial or Ethernet connections).

Only HA-based SCPs are hot-swappable and only HA-based SCPs are supported in the MSC-900. These instructions apply only to HA-based SCPs.

- 1. Loosen the captive fasteners on either edge of the SCP using a straight screwdriver.
- 2. Pull firmly and carefully on the two captive fasteners, removing the SCP from the multiplexer module as shown in Figure 3.4.

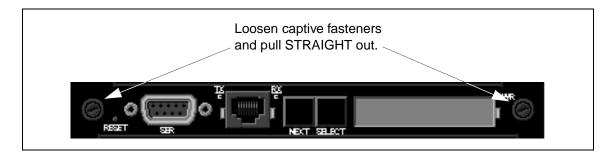


Figure 3.4 - Removal of an SCP

3. Set the old SCP aside.

CAUTION



Take care to properly align the SCP in the card guides in the following step.

- 4. Insert the new SCP into the multiplexer module by sliding it into the card guides.
- 5. Push firmly to seat the SCP so that its faceplate is flush with the front panel of the multiplexer module.
- 6. Re-tighten the captive fasteners with a straight screwdriver to ensure the SCP is secure.

Once the SCP has been installed and the MSC-900 boots, the PVCs will be re-established provided that none of the network modules were replaced after the SCP was removed and provided that all of these steps have been performed properly.

3.5 Multiplexer Module Replacement

The multiplexer modules in the MSC-900 are hot-swappable, meaning that they can be removed and replaced with the chassis under power. The proper procedure for hot-swapping a multiplexer module is as follows:

WARNING!



It is highly recommended that you use the included grounding strap when handling this, or any other component.

CAUTION



Ensure that any unpopulated multiplexer module slots are covered with a blank panel before turning on your MSC-900. Operating the unit with any of these slots left open can cause a significant temperature rise in a very short time.



As a precaution, it is recommended that you back up your CDB before performing this process. Instructions for backing up your CDB can be found in the *ForeThought-SP AMI Reference Manual*.



Replace a multiplexer module ONLY with another multiplexer module (i.e., do not put a TNX-1100 switch fabric into an MSC-900).



To ensure that the MSC-900 will work with the previously established network configuration, the relative position of the network modules must not change when you transfer them to the new multiplexer module. For example, an OC-3c network module that is removed from slot A of the old module must be installed in slot A of the new module. Therefore, it is recommended that you label all network connections and network modules before removing them.



To maintain your CDB, the SCP must be removed <u>before</u> the network modules are removed and it must be installed in the new multiplexer module <u>after</u> the network modules have been installed.

- 1. Log out of all open AMI sessions on the multiplexer module that is to be replaced.
- 2. Remove the SCP from the old multiplexer module using the instructions found in Section 3.4, Switch Control Processor Replacement. Place the SCP on a clean, static-free work area.
- 3. Label and remove all fibers or coaxial cables connected to the ports on the multiplexer module that is to be replaced. Then label and remove all network modules from the old multiplexer module using the instructions found in Section 3.1, Network Module Replacement. Place the network modules on a clean, static-free work area.
- 4. Unscrew the retaining screws at the top and bottom of the multiplexer module with a 3/32-inch Allen wrench. On an MSC-900, press the top black locking tab up towards the top and bottom black locking tab down towards the bottom of the chassis until they are parallel with the front panel of the MSC-900.
- 5. Using the tabs as a handle, pull the multiplexer module out of the chassis.

CAUTION



Make sure the replacement module is properly aligned in the slot in the next step.

- 6. <u>Carefully</u> slide the replacement module into the chassis using enough force to ensure that the connectors on the module mate with the connectors in the chassis.
- 7. Be sure to align the holes properly and screw the module into the chassis using the screws at the top and bottom of the module. Tighten until snug, but do not overtighten.
- 8. Re-install the network modules using the instructions found in Section 3.1, Network Module Replacement. Reconnect all fibers or coaxial cables to the ports.
- 9. Re-install the SCP using the instructions found in Section 3.4, Switch Control Processor Replacement.

Once the SCP has been installed and the system reboots, the PVCs will be re-established if all of the steps have been performed correctly and in the proper sequence.

Hardware Maintenance Procedures

Network Module Hardware

This appendix contains information about network module LEDs, their indications, and network module loopback modes.

4.1 Network Module LED Indicators

Table 4.1 describes the possible states and meanings for the LEDs on the front panels of the network modules.

Table 4.1 - Guide to Network Module LED Indicators

Network Module Type	Indicator	State	Meaning
SONET - LAN1	Transmit	Green or Extinguished	In normal operation this LED is flashing green indicating traffic flow, either input or output. AMI displays this as AUTO.
		Red	N/A
		Yellow	N/A
	Receive	Green or Extinguished	In normal operation this LED is flashing green indicating traffic flow, either input or output. AMI displays this as AUTO.
		Red	Either LOS or LOF or AIS_L or (LOP_P or UNEQ_P or PLM_P or LCD) AND (not AIS_P)
		Yellow	RDI_L
SONET - WAN1	Transmit	Green	Normal operation
		Red	N/A
		Yellow	N/A
	Receive	Green	Normal operation
		Red	Either LOS or LOF or AIS_L or (LOP_P or UNEQ_P or PLM_P or LCD) AND (not AIS_P)
		Yellow	RDI_L

Table 4.1 - Guide to Network Module LED Indicators

Network Module Type	Indicator	State	Meaning
SONET - LAN2 or WAN2	Transmit	Green or Extinguished	In normal operation this LED is flashing green indicating traffic flow, either input or output. AMI displays this as AUTO.
		Red	RDI_L
		Yellow	RDI_P
	Receive	Green or Extinguished	In normal operation this LED is flashing green indicating traffic flow, either input or output. AMI displays this as AUTO.
		Red	Either LOS or LOF or AIS_L
		Yellow	AIS_P or LOP_P or UNEQ_P or PLM_P or LCD
DS1, DS3, E1, E3, J2, TAXI, TP25	Transmit	Off	No cells being transmitted from the port.
		Green	Cell is being transmitted on the port.
	Receive	Off	Carrier has been detected on the line. A carrier is detected when there is a proper voltage signal on the line.
		Green	Cell is being received on the port.
		Red	Loss of Carrier

4.2 Loopback Testing

All network module ports are capable of loopback modes of varying types, depending on the interface. All the loopback modes are available in AMI at the configuration port level. The port level is broken down by interface type, such as configuration port ds1 loopback.

Check the options available for each interface in the AMI to be sure the loopback test you wish to perform is supported by the hardware.



Loopback tests require equipment capable of sending, receiving and analyzing a data stream. Testing is done link by link (no switching of the data stream) between any two points. If any switching is required between the source and destination, remember the VPI/VCI of the outgoing cells must be such that the it will return to the source.

4.2.1 Configuring SONET Loopback

To facilitate testing of the SONET ports, there are three different loopback configurations available: line and diagnostic. When a SONET port is in loopback mode, it no longer passes normal traffic.

To change the loopback state on a SONET port, log in to AMI and enter the following parameters:

```
configuration port sonet loopback <port> (line | diag | path | none)
```

The <port> variable indicates the SONET port that is to be modified and the (line |diag |path | none) variable indicates the type of loopback to be used on the specified port. The default loopback setting is none which means that no loopback takes place on that port. If there are no SONET ports on the multiplexer module, then this option is not valid.

After the loopback mode is modified on a SONET port, the SCP immediately puts that change into effect on that multiplexer module. At the same time, that information is entered into the configuration database file on the SCP so that the change is put into effect every time the MSC-900 software starts on that particular SCP.

4.2.1.1 Line Loopback

Line loopback connects the transmitter to the receiver. The data stream received from the fiber is retransmitted back out to the fiber. In line loopback, the port acts as if it were an optical repeater. Cells generated by the SCP to this port are not sent over the fiber. This option is valid for all SONET network modules.

4.2.1.2 Diagnostic Loopback

Diagnostic loopback connects the receiver to the transmitter. The SONET stream being transmitted by the SCP to a port is looped back to the SCP. The stream is still transmitted over the fiber, but the incoming stream is ignored. This option is valid for all SONET network modules, except for Series C OC-12 network modules.

4.2.1.3 Path Loopback

Path loopback is another form of diagnostic loopback in which the path block receiver is connected to the path block transmitter. This option is valid ONLY for Series C OC-12 network modules.

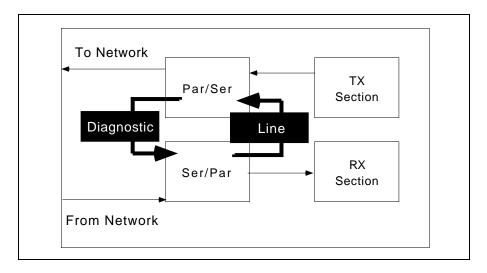


Figure 4.1 - SONET Single Port Loopback Diagram

4.2.2 Configuring DS3 Loopback

In order to facilitate testing of the DS3 ports, there are four different loopback configurations available: cell, payload, diagnostic, and line. When a DS3 port is in loopback mode, it no longer passes normal traffic.

To change the loopback state on a DS3 port, log in to AMI and enter the following parameters:

```
conf port ds3 loopback <port> (cell | payload | diag | line | none)
```

The *<port>* variable indicates the DS3 port that is to be modified and the (cell|payload|diag|line|none) variable indicates the type of loopback to be used on the specified port. The default loopback setting is none, which means that no loopback takes place on that port. If there are no DS-3 ports on the multiplexer module, then this option is disabled.

After the loopback state is modified on a DS3 port, the SCP immediately puts that change into effect on that multiplexer module. At the same time, that information is entered into the CDB file so that the change is put into effect every time the MSC-900 software starts on that particular SCP.

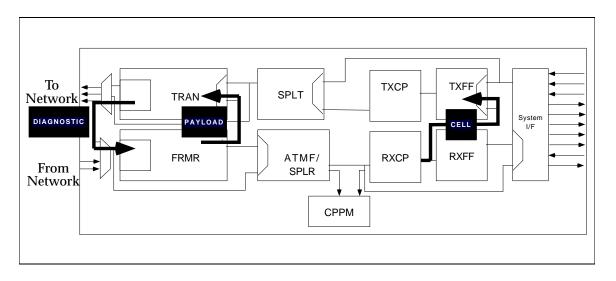


Figure 4.2 - DS3 Single Port Loopback Diagram

4.2.2.1 Cell Loopback

When enabled, the DS3 stream is received from the network, unframed into ATM cells, reframed, and then transmitted back to the network.

4.2.2.2 Payload Loopback

When enabled, the DS3 stream is received from the network, has the DS3 overhead bits reinserted, and is retransmitted to the network.

4.2.2.3 Diagnostic Loopback

This connects the receiver to the transmitter. The DS3 stream transmitted by the MSC-900 to a port is looped back to the concentrator. The DS3 stream is still transmitted to the network, but the incoming DS3 stream is ignored.

4.2.2.4 Line Loopback

Line loopback connects the transmitter to the receiver. The data stream received from the line is retransmitted back out to the line. Cells generated by the MSC-900 to this port are not sent over the line.

4.2.3 Configuring DS1 Loopback

To facilitate testing of the DS1 ports, there are three different loopback configurations available: line, payload, and diagnostic. When a DS1 port is in loopback mode, it no longer passes normal traffic.

To change the loopback state on a DS1 port, log in to AMI and enter the following parameters:

configuration port ds1 loopback <port> (line | payload | diag | none)

After the loopback state is modified on a DS1 port, the SCP immediately puts that change into effect on that multiplexer module. At the same time, that information is entered into the CDB file so that the change is put into effect every time the software starts on that particular SCP.

4.2.3.1 Line Loopback

Line loopback connects the transmitter to the receiver. The data stream received from the line is retransmitted back out to the line. Cells generated by the MSC-900 to this port are not sent over the line.

4.2.3.2 Payload Loopback

When enabled, the DS1 stream received from the network has the DS1 overhead bits reinserted and the stream is retransmitted to the network.

4.2.3.3 Diagnostic Loopback

This connects the receiver to the transmitter. The DS1 stream transmitted by the MSC-900 to a port is looped back to the MSC-900. The DS1 stream is still transmitted to the network, but the incoming DS1 stream is ignored.

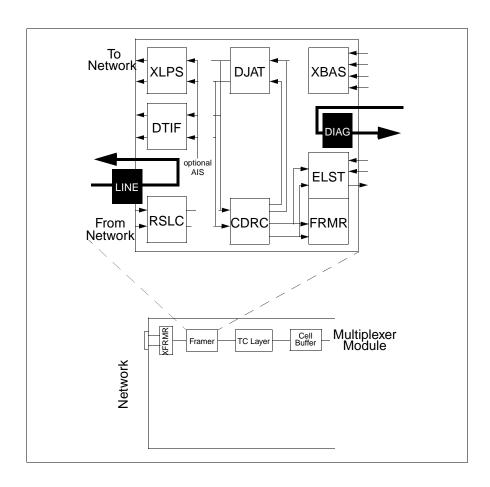


Figure 4.3 - DS1 Single Port Loopback Diagram

4.2.4 Configuring CESDS1 Loopback

To facilitate testing of the CESDS1 ports, line loopback is available. When a CESDS1 port is in loopback mode, it no longer passes normal traffic.

To change the loopback state on a CESDS1 port, log in to AMI and enter the following parameters:

```
configuration port cesds1 loopback <port> (line | none)
```

The *<port>* variable indicates the DS1 port that is to be modified and the (line|none) variable indicates the type of loopback to be used on the specified port. The default loopback setting is none, which means that no loopback takes place on that port. If there are no CESDS1 ports on the MSC-900, then this option is disabled.

After the loopback state is modified on a CESDS1 port, the SCP immediately puts that change into effect on that multiplexer module. At the same time, that information is entered into the CDB file so that the change is put into effect every time the MSC-900 software starts on that particular SCP.

4.2.4.1 Line Loopback

Line loopback connects the transmitter to the receiver. The data stream received from the line is retransmitted back out to the line. Cells generated by the MSC-900 to this port are not sent over the line.

4.2.5 Configuring E3 Loopback

To facilitate testing of the E3 ports, there are four different loopback configurations available: cell, payload, diagnostic, and line. When an E3 port is in loopback mode, it no longer passes normal traffic.

To change the loopback state on an E3 port, log in to AMI and enter the following parameters:

```
conf port e3 loopback <port> (cell | payload | diag | line| none)
```

The *<port>* variable indicates the E3 port that is to be modified and the (cell|pay-load|diag|line|none) variable indicates the type of loopback on the port. The default loopback setting is none which means that no loopback takes place on that port. If there are no E3 ports on the multiplexer module, then this option is disabled.

After the loopback mode is modified on a E3 port, the SCP immediately puts that change into effect on that multiplexer module. At the same time, that information is entered into the CDB file on the SCP so that the change is put into effect each time the MSC-900 software starts on that particular SCP.

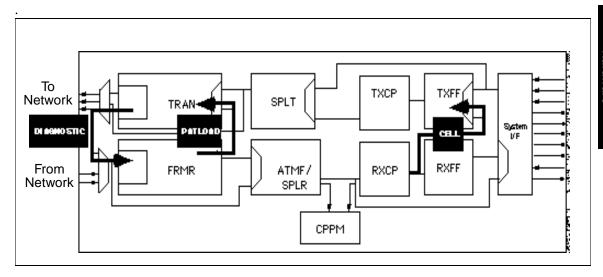


Figure 4.4 - E3 Loopback

4.2.5.1 Cell Loopback

When enabled, the E3 stream received from the network is unframed into ATM cells. The cells are then reframed and transmitted back to the network.

4.2.5.2 Payload Loopback

When enabled, the E3 stream received from the network has the E3 overhead bits re-inserted and is retransmitted to the network.

4.2.5.3 Diagnostic Loopback

This connects the receiver to the transmitter. The E3 stream transmitted by the SCP to a port are looped back to the SCP. The E3 stream is still transmitted to the network, but the incoming E3 stream is ignored.

4.2.5.4 Line Loopback

Line loopback connects the transmitter to the receiver. The data stream received from the line is retransmitted back out to the line. Cells generated by the SCP to this port are not sent over the line.

4.2.6 Configuring E1 Loopback

To facilitate testing of the E1 ports, there are three different loopback configurations available: line, payload, and diagnostic. When an E1 port is in loopback mode, it no longer passes normal traffic.

To change the loopback state on an E1 port, log in to AMI. Enter the following parameters:

```
configuration port el loopback <port> (line | payload | diag | none)
```

The <port> variable indicates the E1 port that is to be modified and the (line|payload|diag|none) variable indicates the type of loopback on the port. The default loopback setting is none which means that no loopback takes place on that port. If there are no E1 ports on the multiplexer module, then this option is disabled.

After the loopback mode is modified on an E1 port, the SCP immediately puts that change into effect on that multiplexer module. At the same time, that information is entered into the CDB file on the SCP so that the change is put into effect each time the MSC-900 software starts on that particular SCP.

4.2.6.1 Line Loopback

Line loopback connects the transmitter to the receiver. The data stream received from the line is retransmitted back out to the line. Cells generated by the SCP to this port are not sent over the line.

4.2.6.2 Payload Loopback

When enabled, the E1 stream received from the network has the E1 overhead bits re-inserted and is retransmitted to the network.

4.2.6.3 Diagnostic Loopback

This connects the receiver to the transmitter. The E1 stream transmitted by the SCP to a port is looped back to the SCP. The E1 stream is still transmitted to the network, but the incoming E1 stream is ignored.

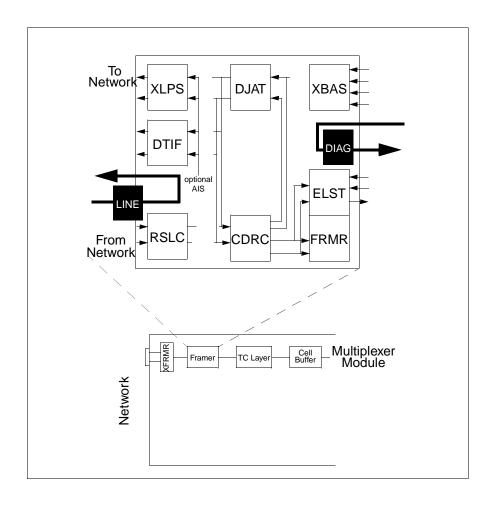


Figure 4.5 - E1 Single Port Loopback Diagram

4.2.7 Configuring CESE1 Loopback

To facilitate testing of the CESE1 ports, line loopback is available. When a CESE1 port is in loopback mode, it no longer passes normal traffic.

To change the loopback state on a CESE1 port, log in to AMI. Enter the following parameters:

```
configuration port cese1 loopback <port> (line | none)
```

The <port> variable indicates the CESE1 port that is to be modified and the (line|none) variable indicates the type of loopback on the port. The default loopback setting is none which means that no loopback takes place on that port. If there are no CESE1 ports on the multiplexer module, then this option is disabled.

After the loopback mode is modified on a CESE1 port, the SCP immediately puts that change into effect on that multiplexer module. At the same time, that information is entered into the CDB file on the SCP so that the change is put into effect each time the MSC-900 software starts on that particular SCP.

4.2.7.1 Line Loopback

Line loopback connects the transmitter to the receiver. The data stream received from the line is retransmitted back out to the line. Cells generated by the SCP to this port are not sent over the line.

4.2.8 Configuring J2 Loopback

To facilitate testing of the J2 ports, there are two different loopback configurations available: line and diagnostic. When a J2 port is in loopback mode, it no longer passes normal traffic. To change the loopback state on a J2 port, log in to AMI and enter the following parameters:

```
configuration port j2 loopback confi
```

The <port> variable indicates the J2 port that is to be modified and the (line|diag|none) variable indicates the different types of loopback. The default setting is none which means that no loopback takes place on that port. If there are no J2 ports on the multiplexer module, this option is disabled.

After the loopback mode is modified on a J2 port, the SCP immediately puts that change into effect on that multiplexer module. At the same time, that information is entered into the CDB file on the SCP so that the change is put into effect each time the MSC-900 software starts on that particular SCP.

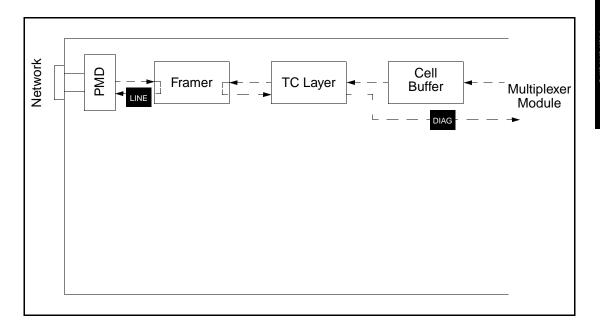


Figure 4.6 - J2 Single Port Loopback Diagram

4.2.8.1 Line Loopback

Line loopback connects the transmitter to the receiver. The data stream received from the coaxial cable is retransmitted back out to the line. Cells generated by the SCP to this port are not sent over the line.

4.2.8.2 Diagnostic Loopback

Diagnostic loopback connects the receiver to the transmitter. The J2 stream being transmitted by the SCP to a port is looped back to the SCP. The stream is still transmitted over the line, but the incoming stream is ignored.

4.2.9 Configuring TP25 Loopback

To facilitate testing of the TP25 ports, a line loopback configuration is available. When a TP25 port is in loopback mode, it no longer passes normal traffic.

To change the loopback state on a TP25 port, log in to AMI. (Please refer to Chapter 1 of the *ForeThought-SP AMI Reference Manual* for information about logging into AMI). Enter the following parameters:

```
configuration port tp25 loopback <port> (line | none)
```

The <port> variable indicates the TP25 port that is to be modified and the (line|none) variable indicates the type of loopback on the port. The default loopback setting is none which means that no loopback takes place on that port. If there are no TP25 ports on the MSC-900, then this option is disabled.

After the loopback mode is modified on a TP25 port, the SCP immediately puts that change into effect on that multiplexer module. At the same time, that information is entered into the configuration database file so that the change is put into effect each time the MSC-900 software starts on that particular SCP.

4.2.9.1 Line Loopback

Line loopback connects the transmitter to the receiver. The data stream received from the line is retransmitted back out to the line. Cells generated by the MSC-900 to this port are not sent over the line.

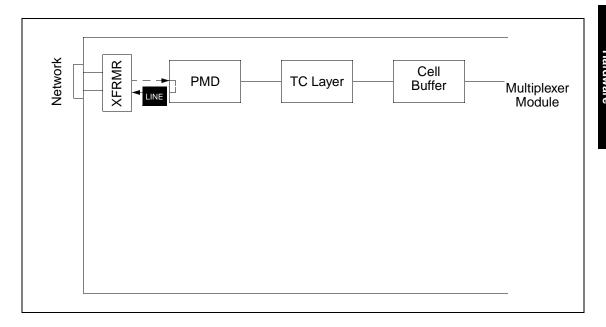


Figure 4.7 - TP25 Single Port Loopback Diagram

4.2.10 Configuring TAXI Loopback

To facilitate testing of the TAXI ports, a diagnostic loopback configuration is available. When a TAXI port is in loopback mode, it no longer passes normal traffic. To change the loopback state on a TAXI port, log in to the ATM Management Interface (AMI) and open a session. (Please refer to Chapter 1 of the *ForeThought-SP AMI Reference Manual* for information about logging into AMI.) Enter the following parameters:

```
configuration port taxi loopback <port> (diag | none)
```

The <port> variable indicates the TAXI port that is to be modified and the (diag|none) variable indicates the type of loopback to be used on the specified port. The default loopback setting is none, which means that no loopback takes place on that port. If there are no TAXI ports on the multiplexer module, then this option is disabled.

After the loopback state is modified on a TAXI port, the switch control processor (SCP) immediately puts that change into effect on that multiplexer module. At the same time, that information is entered into the configuration database file on the SCP so that the change is put into effect every time the MSC-900 software starts on that particular SCP.

Network Module Hardware

CHAPTER 5

Software Upgrade Instructions

This chapter details the steps necessary to upgrade the *ForeThought-SP* software on your MSC-900. Read the following list to better understand how the instructions are ordered before moving on:

- **Section 5.1 -** Obtaining the Software Upgrade File
- Section 5.2 Performing the Software Upgrade
- Section 5.3 Changing between Multiple Versions of Software
- Section 5.4 Using bootp to Download Software to the MSC-900

CAUTION



As a precaution, it is recommended that you back up your CDB before beginning the upgrade process. For more information, see the *ForeThought-SP AMI Reference Manual*.



Each of the SCPs on a TNX-1100 must be upgraded individually.



The operation upgrade command can be issued one of two ways, depending on how TFTP is configured on the UNIX workstation that holds the upgrade file. For more information about using this command, see Section 5.2 and Section 5.4.4.

5.1 Obtaining the Software Upgrade File

Before beginning the upgrade process, you will need the upgrade file from FORE Systems. This file can be obtained via FTP or diskette. To obtain the file via FTP, you must have FTP access. To obtain the file from diskette, you will need the distribution diskettes from FORE Systems.

You will also need a UNIX workstation with at least 5 Mbytes of free disk space. If you are upgrading from the distribution diskettes, the UNIX workstation must also be equipped with a floppy drive. The UNIX workstation must be connected (via ATM or Ethernet) to the SCP being upgraded.

5.1.1 Obtaining the Software Upgrade File via FTP

The software upgrade can be retrieved from FORE Systems via anonymous FTP using the following procedure. First, FTP to ftp.fore.com. and log in as anonymous. Enter your full email address (e.g., jdoe@somewhere.com) when you are prompted for a password.



For security reasons, your password is not echoed.

Once you connect to FORE's FTP site (you will see the ftp> prompt), you must change to the /priv/release/sunny directory. This directory contains the *ForeThought* SP software upgrade files and the .readme files which contain important information about the software release.



Because the contents of this directory cannot be listed, please contact FORE Technical Support to obtain the latest list of file names.

The .readme files can be retrieved as ASCII text. However, before you retrieve the software files, you must switch the transfer mode to binary.

The following script is an example of how you might retrieve the software and .readme files. User input is shown in **bold** courier font.

```
server-jdoe:52=> ftp ftp.fore.com
Connected to ftp.fore.com.
220 ftp.fore.com FTP server (Version wu-2.4(4) Tue Apr 11 13:53:34 EDT 1995) ready.
Name (ftp.fore.com:jdoe): anonymous
331 Guest login ok, send your complete e-mail address as password.
Password: TYPE YOUR FULL E-MAIL ADDRESS HERE <ENTER>
230-
230-
                   WELCOME to the FORE Systems FTP Server!
230-
230- We are currently making many changes to the server to make it easier
230- for you use and search for the files that you are looking for.
230- Announcements regarding these changes will be posted here as they
230- are completed.
230-
230- If you have any problems finding the files that you are looking for,
230- you can contact FORE Systems Technical Support by phone or send email
230- to support@fore.com.
230-
230- Abuse of any FORE Systems Technical Services system is grounds for the
230- immediate removal of all access.
230-
230-
230 Guest login ok, access restrictions apply.
ftp> cd /priv/release/sunny <ENTER>
250 CWD command successful.
ftp> get s_ft_sp_1.0.0_1.20.readme <ENTER>
200 PORT command successful.
150 Opening ASCII mode data connection for s_ft_sp_1.0.0_1.20.readme (51578 bytes).
226 Transfer complete.
local: s_ft_sp_1.0.0_1.20.readme remote: s_ft_sp_1.0.0_1.20.readme
51578 bytes received in 1 seconds (50 Kbytes/s)
ftp> binary <ENTER>
200 Type set to I.
ftp> get s_ft_sp_1.0.0_1.20 <ENTER>
200 PORT command successful.
150 Opening BINARY mode data connection for s_ft_sp_1.0.0_1.20 (8147013 bytes).
226 Transfer complete.
local: s_ft_sp_1.0.0_1.20 remote: s_ft_sp_1.0.0_1.20
8147013 bytes received in 2.3e+02 seconds (35 Kbytes/s)
ftp> quit <ENTER>
221 Goodbye.
```

If you have retrieved a software file with a .Z extension, then you need to uncompress the file using the following command:

where *<filename>* represents the full name of the upgrade file you have retrieved. For example, using the software file from the previous example:



If you have retrieved a software file with a .tar extension, do NOT untar it. The operation upgrade command in the ATM Management Interface (AMI) will expect the upgrade file to be in tarfile format.

If you have difficulty retrieving the files or if you have any other questions regarding the FTP site, please contact FORE Systems' Technical Support by sending e-mail to support@fore.com or by calling 800-671-FORE.

Once you have successfully retrieved the software upgrade file via FTP, follow the instructions in Section 5.2.

5.1.2 Obtaining the Software Upgrade File via Diskette

Using the FORE Systems distribution diskettes, the upgrade software must be installed on a workstation attached (via Ethernet or ATM) to the SCP being upgraded. The first disk contains a part of the distribution software, as well as a script that extracts the remaining software from the rest of the disks and builds the upgrade distribution on the workstation. The first disk can be extracted using the tar command:

where *<device>* is the block device name of the floppy drive. This disk should then be ejected from the floppy drive. On a SunOS system, the following command will eject a disk:

where <device> is the block device name of the floppy drive. On other operating systems, there may be a different command for ejecting a floppy disk or there may be a manual eject button. If there is a manual eject button, eject the disk and proceed. If there is a UNIX command for ejecting the floppy, use that command to eject the floppy and proceed.

At this point, two files should have been created: fore_extract and TNX-210_<*version>* (where <*version>* is the new software version). The fore_extract file is the script that will extract the files from the other floppies. If there is a command to eject a floppy on your system, set the following environment variable so the fore_extract script can properly eject the floppies:

setenv FORE EJECT <eject command> (for csh)

or

```
FORE_EJECT<=eject_command>;export FORE_EJECT (for sh)
```

On a Sun running SunOS 4.1.x, set the following environment variable so the fore_extract script can properly eject the floppies:

setenv FORE EJECT eject

Execute the fore_extract script with the following command:

```
./fore_extract <device>
```

Once again, <device> is the block device name of the floppy drive. You will be asked to insert the remaining disks in sequence. If these steps are performed correctly, something similar to the following should appear on the screen:

```
filename: TNX-210_< version>
directory: <directory from which it was extracted>
```

The fore_extract script will create a file called TNX-210_<version> in the current directory. This is the file that the SCP will use to upgrade its software. You will need to provide this filename and path later during the upgrade process.

5.2 Performing the Software Upgrade

The software upgrade is performed with the operation upgrade command in AMI. The underlying file transfer mechanism used in the upgrade is TFTP. TFTP can run in "secure" or "unsecure" mode, and it is assumed that your TFTP server is running in secure mode. Therefore, if TFTP is to run properly between, the file(s) being transferred must reside in the /tft-pboot directory on the source machine (see Section 5.4.4 for more information).

To perform an upgrade, the MSC-900 initiates a TFTP session with the specified host, which searches for the file requested. The host, which is running TFTP, looks for the file in /tftp-boot. The TFTP process on the server automatically appends "/tftpboot" to the path or filename specified by the client.

For example, issuing operation upgrade 169.144.3.54:s_ft_sp_1.0.0_1.20 will cause the TFTP server to locate and transfer the file /tftpboot/s_ft_sp_1.0.0_1.20. For this reason, it is imperative that you place the upgrade file in the /tftpboot directory on the workstation to which you downloaded or extracted the file. If this directory does not already exist, it is likely that TFTP is not running on the workstation. See Section 5.4.4 for instructions on setting up a TFTP server and placing the upgrade file in the /tftpboot directory.

Once you have verified your TFTP server and placed the software upgrade file, you need to invoke the upgrade process on the SCP. Log in to AMI and enter the following parameters at the localhost::> prompt:

operation upgrade ?

This will display the specific parameters that you need to enter as follows:

upgrade <remotehost>:<full path to remotefile>

In the <remotehost> field, enter the remote machine name or IP address of the workstation which holds the upgrade file. In the <full path to remotefile> field, enter ONLY the filename of the upgrade file.



If you obtained the upgrade file via FTP, <full path to remotefile> is the name of the uncompressed file. If you obtained the file from diskette, <full path to remotefile> is the name printed during extraction.

For example, you would enter something similar to the following:

operation upgrade 169.144.3.54:s_ft_sp_1.0.0_1.20

You should receive messages similar to the following:

Received 688128 bytes in 5.3 seconds upgrade successful

Reboot the switch[y]?



You have an important decision to make now. At this point, the boot pointer will have the new software's filename in it. A reboot will load the new version of software to FLASH, and the MSC-900 will be running the upgraded version when it comes up. If you wish, however, you can still run the old version of software. If you want to use the old version and change to the new version at a later time, enter n at the reboot prompt and follow the instructions in Section 5.3

To use the new version of software that you have just loaded, type **y** and press **<ENTER>** or simply press **<ENTER>** to reboot.

Reboot the switch[y]? y

Once the SCP reboots, all active AMI sessions will be terminated on the SCP. You will need to log in to AMI again if you want to begin another session.



If something went wrong during the upgrade process, a new file named UPGRADE will appear in the FLASH file system and you will not be prompted with the "Reboot the switch [y]?" message.

If the upgrade is unsuccessful or if you have any other problems with the upgrade, please contact FORE Systems' Technical Support.

5.3 Changing between Multiple Versions of Software

It is possible to select between multiple versions of installed software at any time (not just during an upgrade procedure). You can display all the versions that are installed by typing the following:

```
localhost::operation flash> dir
SP100.35
CURRENT
SP111.25
```

However, in this list, CURRENT is simply a pointer to the version that will be used as the current MSC-900 software during a reboot. To display the version to which CURRENT is pointing, as well as all the versions that are installed, type the following:

```
localhost::operation> version
Software versions installed : SP100.35 SP110.25
Current software version is SP100.35
```

Notice that no parameter for **version** was specified above. If no parameter is specified, it will list the current and installed versions, but will not change anything.

In this example, to change the current version of software from ${\tt SP100.35}$ to ${\tt SP110.25}$, type the following:

localhost::operation> version SP110.25
Current software version is SP110.25
Software versions installed : SP100.35 SP110.25



By using the operation version command and specifying a version, you change the version to which CURRENT is pointing.

At this point, the MSC-900 is still running ${\tt SP100.35}$, but CURRENT is pointing to ${\tt SP110.25}$. To make the change complete, enter the following:

localhost::operation> reboot
Are you sure you want to reboot this switch [n]? y

When the SCP reboots, it will look to see to which version CURRENT is pointing. In this case, it will see SP110.25 and boot using that version.

5.4 Using bootp to Download Software to the MSC-900



Section 5.4 needs to be performed <u>only</u> if your SCP fails to boot from FLASH.



Booting via bootp does not upgrade the software on your MSC-900. If you use bootp to start your MSC-900, then you must upgrade the software image in FLASH memory according to the instructions in Section 5.2.

If your SCP fails to boot from FLASH, and no bootp server is available, the output on your terminal will look similar to the following:

```
Switch Control Processor-16 Jan 17 1995
Copyright 1994, FORE Systems, Inc.
Copyright 1992, Intel Corporation

Attempt Ethernet boot
ie_attach: ie0 ethernet address 00:20:48:20:00:19
BootP:: Waiting 68 seconds.
BootP:: Waiting 142 seconds.
BootP:: Waiting 202 seconds. "BootP..." in display
BootP:: Waiting 262 seconds.
BootP:: Waiting 322 seconds.
No response to BootP

Attempt Ethernet boot
ie_attach: ie0 ethernet address 00:20:48:20:00:19
BootP:: Waiting 68 seconds.
...
```

This cycle will continue indefinitely until the MSC-900 is powered down or reset. If you see output similar to this after an upgrade, then you will need to set up a bootp server as detailed in the following sections.

5.4.1 Overview

Each FORE SCP comes with its hardware address (Ethernet MAC address) burned in from the factory, but it does not come preconfigured with an IP address. Any time that the MSC-900 is turned on, the SCP attempts to boot from FLASH memory.

If an SCP cannot boot from its FLASH (e.g., the FLASH has recently been initialized or the MSC-900 software image in the FLASH is corrupt), it attempts to locate a bootp server on its Ethernet interface.

The SCP broadcasts its Ethernet MAC address in a bootp datagram. Bootp servers on the network that receive that broadcast look up that MAC address in their bootptab file. If they find an entry for that MAC address, they broadcast a reply to the SCP that contains a pointer to a MSC-900 software image file residing on the bootp server.

When the SCP sees the bootp reply, it initiates a TFTP session with the bootp server using the path and filename returned in the datagram from the server.

5.4.2 Setting Up a bootp Server

If the process described above is to happen, you need to provide the bootp server with the SCP's Ethernet MAC address and the path to the MSC-900 software image.

Before the bootp server will work, you must add or uncomment the following line in /etc/inetd.conf:

bootps dgram udp wait root /etc/bootpd -d4 /etc/bootptab

with the bootpd and the bootptab files in the /etc directory. Also, the following line must appear in /etc/services:

bootp 67/udp bootps

Before any of the above changes can take effect, inetd must re-read the configuration file.



If you need to set up a TFTP server, as described in Section 5.4.4, the following process is not necessary at this time. Instead, make inetd reread its configuration file after setting up your server.

Determine the process number of inetd by entering the following:

```
host: ps -aux | grep inetd
```

Something similar to the following will be displayed:

```
root 216 0.0 0.0 48 0 ? IW Jan 27 0:14 inetd
```

where 216 represents the process number of inetd.

Now that you know the process number, enter the following command line to make inetd reread its configuration file:

```
host: kill -HUP 216
```

5.4.3 Adding an MSC-900 Entry in the bootptab File

On the workstation that is the bootp server, add the following lines to /etc/bootptab:



The lines given here are an example. See the descriptions that follow for an explanation of the values that you need to enter on your SCP.

```
myswitch:\
    :ht=ether:\
    :ha=002048200019:\
    :sm=255.255.255.0:\
    :bf=upgrade-file:\
    :ip=123.123.123.123:
```



Make sure the last line added to bootptab ends in a colon (:) and not a backslash (\). Otherwise, that line will merge with the next entry, causing your MSC-900 to cycle in its attempts to find a bootp server.



If two SCPs are installed in a multiplexer module, each SCP must have its own entry in the bootptab file to assign each SCP a unique IP address. Using only one entry (i.e., the same IP address) causes unpredictable Ethernet ARP behavior.

The variables in the previous example are defined as follows:

myswitch Indicates the name you have assigned to your SCP.

ht Indicates the hardware type. For the purposes of MSC-900 software image loading, this is ether (stands for Ethernet).

ha Indicates the hardware address. This is the Ethernet MAC address of your SCP that is burned in from the factory. If you connect a terminal device to the SCP's serial port, you will see the Ethernet MAC address displayed during the EPROM boot sequence.

sm Indicates the subnet mask. This is the subnet mask for your network.

bf Indicates the bootfile. This is <your boot image file name>.

ip Indicates the IP address of the SCP's Ethernet interface.



For more information about bootp, please refer to RFC-1048 and RFC-951.

Once these lines are added, the bootp server will be able to tell your SCP where to find the MSC-900 software image to be downloaded. The next step in performing the upgrade is to set up a workstation as a tftpboot server and put the upgrade file (the line indicated by bf in the previous example) there.

5.4.4 Setting Up a TFTP Server

To set up a TFTP server, on a SunOS 4.1.x system, perform the following steps:



This procedure only has to be performed the <u>first</u> time that the MSC-900 is turned on and each SCP is upgraded. The next time that the software is upgraded, put the upgrade file in /tftpboot.

1. In /etc/inetd.conf, uncomment the last line shown below so that the file appears as follows:

```
# Tftp service is provided primarily for booting. Most sites
# run this only on machines acting as "boot servers."
# Since these can be security holes, they are commented out by default.
#
tftp dgram udp wait root /usr/etc/in.tftpd in.tftpd -s /tftpboot
```



-s /tftpboot in the line above indicates the server is running secure TFTP. If -s /tftpboot does not appear, many of the command examples in this chapter are invalid.

2. Add the following line to /etc/services:

```
tftp 69/udp
```

3. Set up the tftpboot directory with the following command lines:

```
host: mkdir /tftpboot
host: cp <upgrade-file> /tftpboot
```

4. At the root level, determine the process number of inetd by entering the following:

```
host: ps -aux | grep inetd
```

Something similar to the following will be displayed:

```
root 216 0.0 0.0 48 0 ? IW Jan 27 0:14 inetd
```

where 216 represents the process number of inetd.

5. Enter the following command to make inetd re-read its configuration file:

```
host: kill -HUP 216
```

APPENDIX A

Troubleshooting

The troubleshooting tests detailed in this appendix will clearly indicate and identify the most common problems in establishing ATM networks. Therefore, before calling FORE Systems' Technical Support, perform these tests to correct or at least pinpoint the problem.

If you need to call Technical Support, please have the results of these tests ready, in addition to the information requested in Section A.3, when reporting your problem.



Before trying the procedures in this appendix, ensure that there are no uplink modules installed in any unsupported slots of the MSC-900 (see Section 1.1.1 and Section 1.1.2 of this manual for more information about access and uplink module slots).

A.1 Adapter Hardware Troubleshooting

The flowchart in Figure A.1 illustrates the tests used to check the basic hardware functionality of a FORE Systems adapter, with the adapter card isolated from the network. The tools used to perform the tests are provided by FORE Systems and the computer hardware vendor. Each of the tests, indicated by the diamond-shaped blocks in Figure A.1, is described individually in the following subsections.

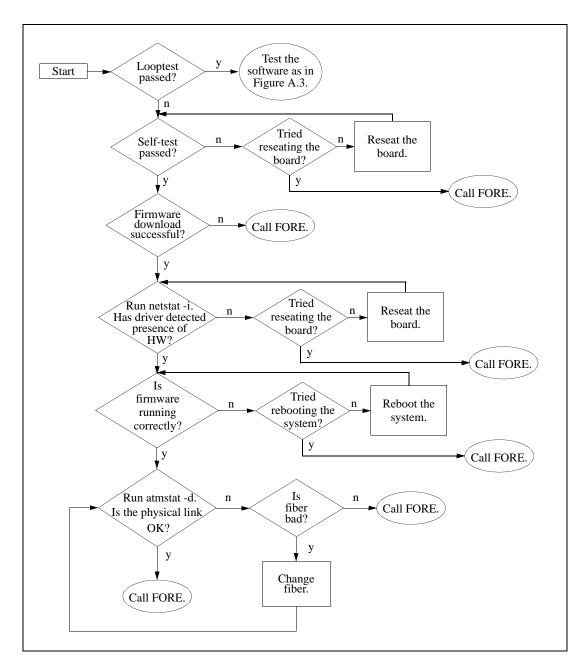


Figure A.1 - Adapter Hardware Troubleshooting Flowchart

A.1.1 Run Looptest

To determine if an interface is functioning properly, run the looptest utility on a host that has been disconnected and isolated from the network.



Before running looptest, the Receive and Transmit connectors on the backplate of the card must be connected to each other using a short loop of fiber-optic cable. This fiber should remain on throughout this test.

The looptest utility uses FORE Systems' ATM user-level Application Programming Interface. For proper operation, looptest requires read/write access to the ATM device. To run looptest, enter the following command at the system prompt in the working directory:

looptest fa0

where fa0 is the default device name for a single ATM adapter.

The looptest utility verifies that the board of an adapter is operating correctly. Correct operation means that all of the following conditions are true:

- 1. The self-test has been passed successfully.
- 2. The firmware has been downloaded successfully.
- 3. The driver has detected the existence of the hardware.
- 4. The firmware is running.
- 5. The physical link is up.

If looptest passes, then the board hardware of the adapter is OK. The next step is to test the software as shown in Figure A.3.

If looptest fails, the point of failure will be indicated by messages generated for each of the five items above. Refer to the following subsections for instructions about testing the individual items.

A.1.2 Check Self-Test (Automatically Performed)

During a system boot, the ATM adapter automatically performs a self-test of the hardware, running a low-level diagnostic which checks memory read/write capability. Upon completion of the self-test, a message is printed to the console of the workstation indicating whether or not the hardware failed.

If the self-test is successful, proceed to the instructions regarding the firmware download as described in the next subsection.

If the self-test fails, reseat the board by performing the following steps to ensure that failure was not due to improper insertion of the board:

- 1. Halt the system, being sure to follow the procedures outlined in Chapter 2 of the User's Manual for the adapter.
- 2. Open the computer as shown in Chapter 2 of the User's Manual for the adapter, and reseat the board.
- Reboot the system.

If the board still fails after a reseat, then it should be returned for repair. Call FORE Systems' Technical Support for further assistance.

A.1.3 Firmware Download (Automatically Performed)

Before operating as an ATM interface, the firmware is automatically downloaded from the system RAM to the onboard i960 processor during host system boot. A message similar to "XXX-200 initializing..." is displayed on the console, indicating that the board is being initialized. When the initialization is complete, success is indicated with the message "done" and failure is indicated with the message "failed."

If the download is successful, check to see if the hardware has been detected by the driver as described in the next subsection.

If the firmware failed to download, then there is most likely a hardware problem. Call FORE Systems' Technical Support for further assistance.

A.1.4 Hardware Detected by Driver

To determine if the driver software on the host has detected the presence of an ATM adapter board, issue the following command once the host system has come up completely:

netstat -i

If the driver has located the ATM board, the screen output shows fa0 in response to the net-stat command. If there is more than one adapter card, the next board will be named fa1, and so on. If you have configured a Classical IP interface, this will also be shown. The option - i shows the state of interfaces that were auto-configured, as happens when the FORE software is loaded and run upon system boot. Interfaces statically configured in a system, but not located at boot time, are not shown.

If the driver does not see the ATM board, no response will be given. Reseat the board by performing the following steps to ensure that failure was not due to improper insertion of the board:

- 1. Halt the system, being sure to follow the procedures outlined in Chapter 2 of the User's Manual for the adapter.
- 2. Open the computer as shown in Chapter 2 of the User's Manual for the adapter, and reseat the board.
- 3. Reboot the system.

If the board still fails after a reseat, then it should be returned for repair. Call FORE Systems' Technical Support for further assistance.

A.1.5 Check Firmware

To check whether or not the firmware is running correctly, issue the following command:

atmstat fa0 1

In this command, the last parameter "1", causes the command to be repeated at one-second intervals.

If the firmware is running correctly, the response will show Input, Output, and Error Statistics for the adapter in the following format:

	PHY/ATM/AAL statistics:								
	Errors			Input	I	Output			
AAL*	AAL*	ATM	4B5B	4B5B	AAL*	ATM	AAL*	ATM	
Proto	Pay-CRC	VPI/VCI	Hdr-CRC	Framing	CS-PDUs	Cells	CS-PDUs	Cells	
0	0	20	0	0	134685	142289	153692	161747	

If the firmware is not running correctly, atmstat hangs and nothing is returned, indicating either a problem with the firmware, a problem with the board, or a severe software failure. Call FORE Systems' Technical Support for further assistance.

If the output shows zeros for all possible values, the firmware may not have been initialized. Try rebooting the system. If there is still a problem, call FORE Systems' Technical Support for further assistance.

A.1.6 Check Physical Link

To see the carrier state of the board, issue the following command:

atmstat -d fa0

The -d option displays device statistics in the following format:

```
Device statistics:

Buffer Allocation Failures

Type 1 Type 2

Small Large Small Large Receive Queue Full Carrier

0 0 0 0 0 0 0 0
```

If ON is displayed in the Carrier field, then the physical link is fine.

If the board does not see a carrier (OFF is displayed in the Carrier field), then there is either a problem with the loopback fiber or there is a hardware problem with the optical drivers on the board. Check the fiber. If the fiber is bad, replace the fiber and run looptest again. If the fiber is not bad, then call FORE Systems' Technical Support for further assistance.

Alternatively, if you have access to the back of the host and can see the LED displays on the adapter backplate, a red LED on the R (Receive port) also indicates carrier failure.

A.2 Testing Network Connectivity Using PVCs

The network connectivity tests require that two ATM adapters be connected to an MSC-900 multiplexer module with PVCs (as shown in Figure A.2). The carrier lights should be extinguished on the adapters and on the multiplexer module, indicating that the fibers are OK.

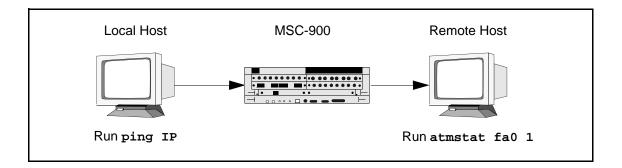


Figure A.2 - Hardware Configuration for Checking PVCs

The network connectivity test suite, shown in Figure A.3, examines higher level functionality after basic adapter board performance has been verified by passing all the tests and checks shown in Figure A.1.

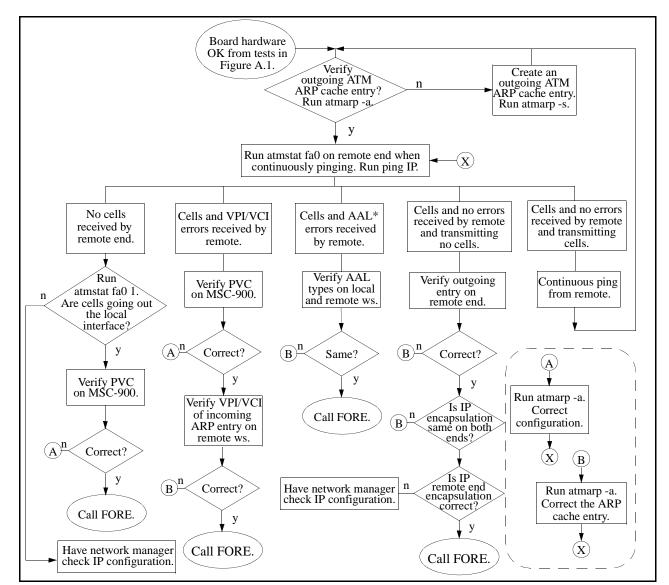


Figure A.3 - Networking Connectivity Using PVCs

This test sequence requires that the multiplexer module be configured with a valid PVC and the endstations to have the proper IP configuration and ATM ARP cache entries. The tests in Figure A.3 assume that there is no IP connectivity between the two endstations. The lack of an IP connection is checked by trying a ping and getting no response (ping failed).

The tests in Figure A.3 also require that if a multiplexer module is used, it is a FORE Systems multiplexer module on which SPANS has been disabled on both the ports of the multiplexer module and on the ATM endstations. SPANS must be disabled because it automatically creates ATM connections, which may alter the test results.

All of the failure conditions are the result of running a continuous ping with the following command:

```
ping <IP_address_of_remote_workstation>
```

A.2.1 Verifying the Outgoing ATM ARP Entry

To verify the outgoing ATM ARP cache entry for the endstation originating the ping, enter the following command on the host:

```
atmarp -a
```

The following is an example of a typical ATM ARP cache display:

Make sure the ARP cache entry does indeed match the IP address of the remote endstation and is using the PVC configured on the multiplexer module.

If the prompt is returned with no information displayed, this indicates that the ATM ARP cache is empty.

Use the following two commands to create a PVC on the host:

```
./atmarp -s <hostname> <device> <vpi> <vci> <aal>
./atmarp -1 <device> <vpi> <vci> <aal>
```

If the ATM ARP cache entry is valid, then perform the instructions in the next subsection for atmstat.

A.2.2 atmstat

To determine a particular failure state, enter the following command on the remote workstation while continuously pinging:

atmstat fa0 1

PHY/ATM/	PHY/ATM/AAL statistics:											
Output Input Errors												
ATM	AAL*	ATM	AAL*	4B5B	4B5B	ATM	AAL*	AAL*				
Cells	CS-PDUs	Cells	CS-PDUs	Framing	Hdr-CRC	VPI/VCI	Pay-CRC	Proto				
161747	153692	142289	134685	0	0	20	0	0				

The failure states are determined by examining the output from the atmstat fa0 1 command string. The failures are classified by whether or not cells are sent (or received) and whether or not errors are received. The output shown below is typical of the first response from the atmstat fa0 1 command string. Succeeding lines of data continue in the same column format. Refer to the following subsections for a description of each type of failure.

A.2.2.1 No Cells Received by Remote End

If no cells are received by the remote end (the Input ATM Cells field displays zero), then run the following command on the local machine to verify that cells are going out to the ATM interface:

atmstat fa0 1

If there are no cells going out (the ATM Output Cells field shows zero), then there is most likely an IP routing problem rather than an ATM problem. Please have your network administrator check the IP configuration.

If cells are going out (the ATM Output Cells field shows a value other than zero), then the PVC on the multiplexer module may be configured incorrectly. Check the PVC configuration. If it is not set up properly, then correct the PVC and rerun the test. If the PVC is configured correctly and the error persists, call FORE Systems' Technical Support for further assistance.

A.2.2.2 Cells and VPI/VCI Errors Received by Remote

If the remote workstation is receiving cells and is receiving VPI/VCI errors, then this indicates that cells are coming into the workstation, but are on a VPI/VCI that may not be configured correctly.

Check the PVC configuration. If it is not set up properly, then correct the PVC and rerun the test. If the PVC is configured correctly and the error persists, then the incoming ARP entry on the remote workstation is most likely the problem. List the ATM ARP cache using atmarp -a and check the incoming ARP entry for that connection.

If the incoming ARP entry is not configured properly, then correct the configuration and rerun the test. If the incoming ARP entry is configured properly and the error persists, then call FORE Systems' Technical Support for further assistance.

A.2.2.3 Cells and AAL* Errors Received by Remote

If the remote workstation is receiving cells and AAL* errors, it is likely that the AAL types of the outgoing entry on the local workstation and the incoming entry on the remote workstation do not match. Check both ATM AAL types using <code>atmstat</code> to see if they match. If they are different, set the AAL parameter to the same type and rerun the test. If they match and the error persists, then call FORE Systems' Technical Support for further assistance.

A.2.2.4 Cells and No Errors Received by Remote and Transmitting No Cells

If the remote workstation is receiving cells with no errors, but is not transmitting any cells, then either the outgoing IP address on the remote end is incorrect or the IP encapsulation does not match on both ends. (A Classical IP PVC uses LLC/SNAP encapsulation while a regular PVC uses AAL5-based, Multiplexing-based (NULL) encapsulation).

First, check the outgoing IP address on the remote end using atmarp -a. If it is not configured properly, then correct the configuration and rerun the test. If the outgoing ARP entry is configured properly, then check to see if the IP encapsulation matches on both ends using atmarp -a.

If the IP encapsulation does not match on both ends, then correct the configuration and rerun the test. If the IP encapsulation matches on both ends and the error persists, then there may be an IP routing problem on the remote host.

The network administrator should verify the IP routing. If there is still a problem, then call FORE Systems' Technical Support for further assistance.

A.2.2.5 Cells and No Errors Received by Remote and Transmitting Cells

If the remote end is receiving cells with no errors and is transmitting cells in response, then the remote end is OK. Looking at Figure A.2, reverse the direction. From the remote host, start a continuous ping and then run these same tests starting again with Section A.2.1. Watch the results of these tests on the local host.

A.3 Collecting Additional Information

Once basic adapter installation and network connectivity have been tested, this section explains how to obtain all of the additional information that you need to have ready before calling FORE Systems Technical Support. This information should exist either on-line (by redirecting the output to a file) or in hard copy form.

A.3.1 Basic Information

The following basic network information is very useful in helping FORE Systems' Technical Support staff troubleshoot your problem:

- 1. Host platform configuration
 - Vendor name
 - Platform type
 - RAM (MB)
 - Disk drive size (approximate)
- 2. Patches installed (very important for SunOS and Solaris)
- 3. Network topology (physical configuration)
 - Sketch and FAX in, if possible

Please have your support contract ID number and serial number ready, also.

A.3.2 Adapter Information

On the host, at a command line, type the following six commands and note the responses:

- uname -a (Shows operating system, and platform names and versions)
- ifconfig fa0 (Shows adapter interface configuration)
- netstat -nr (Shows routing table with destinations, gateways, and flags)
- netstat -in (Shows device names and addresses, and usage information)
- adinfo fa0 (Shows adapter device name and version information)
- atmstat -d fa0 (Shows carrier state and a variety of error counters)

Typical responses are shown under each command. The responses from these commands enable support to gather sufficient information to resolve the majority of problems.



The assumed adapter name in the examples is fa0. On your particular system, the adapter may have a different designation. To check the name of your adapter, use the command: netstat - in.

uname -a

IRIX beluga 5.3 11091812 IP22 mips

ifconfig fa0

fa0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
 inet 198.29.38.206 netmask 0xfffffff00 broadcast 198.29.38.255

netstat -nr

Dantina tables					
Routing tables					
Destination	Gateway	Flags	Refcnt	Use	Interface
127.0.0.1	127.0.0.1	UH	3	2264661	100
198.29.24.0	198.29.16.74	UG	1	9751	fa0
default	192.88.243.19	UG	3	123714	ie0
198.29.16.0	198.29.16.54	U	29	10892307	fa0
204.95.89.0	198.29.16.28	UG	0	2080	fa0
198.29.25.0	192.88.243.19	UG	0	0	ie0
198.29.26.0	192.88.243.19	UG	0	2696	ie0
198.29.27.0	192.88.243.19	UG	0	7853	ie0
198.29.19.0	198.29.16.85	UG	0	0	fa0
192.88.243.0	192.88.243.54	U	350	9188789	ie0
204.120.44.0	192.88.243.19	UG	1	1677	ie0
198.29.28.0	198.29.16.8	UG	0	87706	fa0
198.29.29.0	198.29.16.2	UG	0	0	fa0
198.29.31.0	198.29.16.75	UG	5	16417	fa0
198.29.23.0	192.88.243.53	UG	6	122731	ie0

netstat -in

Name	Mtu	Network	Address	Ipkts	Ierrs	Opkts	Oerrs	Coll
ec0	1500	192.88.243	192.88.243.171	1173050	39926	509363	0	107115
fa0	9188	198.29.38	198.29.38.206	0	0	0	0	0
qaa0	9180	198.29.22	198.29.22.206	0	0	0	0	0
qaa1	*9180	none	none	0	0	0	0	0
qaa2	*9180	none	none	0	0	0	0	0
qaa3	*9180	none	none	0	0	0	0	0
100	8304	127	127.0.0.1	32048	0	32048	0	0

adinfo fa0

FORE Systems Release: ForeThought_3.0.1b (1.20)

fa0: esa-200 media=4b5b-100 hw=1.0.0 fw=2.3.0 serial=2 slot=0

atmstat -d fa0

Device statistics:

Buffer Allocation Failures

Тур	pe 1	Туре	2		
Small	Large	Small	Large	Receive Queue Full	Carrier
0	0	0	0	0	ON

A.3.3 MSC-900 Information

On the host, at a command line, type the following commands and note the responses:

- atmstat fa0 command
- netstat -ai command
- cport command

Log in to the ATM Management Interface (AMI) and open a session on the multiplexer module to check the following:

- configuration spans show
- configuration port show
- configuration uni show

PHY/ATM/AAL statistics:
Output

Configuration of Network Modules (TAXI, DS3, DS1, SONET, E3, E1, and/or J2)

Typical responses are shown under each command. The responses from these commands enables support to gather sufficient information to resolve the majority of problems.

atmstat fa0

Input

A.	ΓM	AAL*	ATM	AAL*	4B5B	4	B5B	ATM		AAL*	AAL*
Cell	ls C	S-PDUs	Cells	CS-PDUs	Framing	Hdr-	-CRC	VPI/VCI	Pay	/-CRC	Proto
47605	58	469354	276580	273789	0		0	0		0	0
				netst	at -ai						
Name	Mtu	Network	Addr	ess	I	okts	Ierr	s Opi	kts	0errs	Coll
ec0	1500	fore	gar-	eth	117	4803	3992	8 509	563	0	107117
			ALL	-SYSTEMS	.MCAST.N						
			08:	00:69:07	:e3:93						
fa0	9188	198.29.38	3 198.	29.38.20	б	0		0	0	0	0
			ALL	-SYSTEMS	.MCAST.N						
qaa0	9180	fore-sw	198.	29.22.20	б	0		0	0	0	0
qaa1	*9180	none	none			0		0	0	0	0
100	8304	loopback	loca	lhost	33	2072		0 32	072	0	0
			ALL	-SYSTEMS	.MCAST.N						

Errors

cport <switch_name>

Input	Ξ.			Output								
Port	Type	Mb/s	State	Time	VPs	VCs	BW	Cells	VPs	VCs	BW	Cells
В1	user	100	down	19:08:15	1	2	100	0	1	2	100	137783
В2	user	100	down	19:08:15	1	2	100	0	1	2	100	137784
В3	user	100	up	19:08:15	1	3	100	141332	1	4	100	149078
В4	user	100	down	19:08:15	1	2	100	0	1	2	100	137784
C1	user	140	up	19:08:15	1	4	140	140569	1	3	140	148928
C2	net	140	up	02:44:38	1	7	140	1046 M	1	6	140	193732
C3	net	140	up	19:08:15	1	5	140	1297 M	1	6	140	455400
C4	user	140	up	19:06:57	1	5	140	138800	1	5	140	1046 M
CTL	user	80	up	19:08:13	1	22	80	1 M	1	22	80	1 M

The following commands are run by logging in to AMI and opening a session on the multiplexer module. Enter the following parameters at the prompt for the type of network modules that are installed in your multiplexer module:

configuration spans show

Port	VPI	State	Type	CDVT	Action	RemoteAddress
1C1	0	down	uni	250	tag	
1C2	0	down	uni	250	tag	
1C3	0	down	uni	250	tag	
1C4	0	up	uni	250	tag	169.144.60.108
1D1	0	down	uni	250	tag	
1D2	0	down	uni	250	tag	
1D3	0	down	uni	250	tag	
1D4	0	down	uni	250	tag	
1CTL	0	up	uni	0	tag	10.10.10.48

configuration port show

Port	Carrier	Mbps	CDVT	Policing	VBROB	BuffOB	AIS/RDI	Model
2A1	no	155.0	250	enabled	100	100	disabled	OC3
2A2	no	155.0	250	enabled	100	100	disabled	OC3
2A3	no	155.0	250	enabled	100	100	disabled	OC3
2A4	no	155.0	250	enabled	100	100	disabled	OC3
2C1	no	155.0	250	enabled	100	100	disabled	OC3
2C2	no	155.0	250	enabled	100	100	disabled	OC3
2C3	no	155.0	250	enabled	100	100	disabled	OC3
2C4	no	155.0	250	enabled	100	100	disabled	OC3
2E1	no	2560.0	100	disabled	100	100	disabled	ASX-BP
2E3	no	2560.0	100	disabled	100	100	disabled	ASX-BP
2E4	no	2560.0	100	disabled	100	100	disabled	ASX-BP
2CTL	ves	80.0	5000	enabled	100	100	disabled	ASX-CTL

configuration uni show

Port	VPI Version	State	ILMI	Side	Type	OperType	RemoteAddress
1D1	0 uni30(a)	up	up	network	auto	FT-PNNI	169.144.64.42
1D2	0 auto (a)	down	down	network	auto	privUNI	
1D3	0 uni30(a)	up	up	user	auto	FT-PNNI	169.144.64.85
1D4	0 auto (a)	down	down	network	auto	privUNI	
1D5	0 uni30(a)	up	up	user	auto	FT-PNNI	169.144.64.232
1D6	0 auto (a)	down	down	network	auto	privUNI	
1CTL	0 uni30(a)	up	down	network	auto	privUNI	

configuration port taxi show

Port	Carrier	State	Loopback
2A1	yes	up	none
2A2	no	down	none
2A3	no	down	none
2A4	no	down	none
2A5	no	down	none
2A6	no	down	none

configuration port ds3 show

Port	Carrier	Status	Mode	Framing	Loopback	Timing	Scrambling	EmptyCells Length
1A1	yes	0x1	plcp	cbit	none	internal	off	unassigned Gt225
1A2	ves	0x1	plcp	cbit	none	internal	off	unassigned Gt225

configuration port ds1 show

Port	Carrier	Status	Mode	Framing	Loopback	Timing	Scrambling	Length	EmptyCells
4C1	no	0x1a0	hcs	ESF	none	internal	off	Lt110	unassigned
4C2	no	0x1a0	hcs	ESF	none	internal	off	Lt110	unassigned
4C3	no	0x1a0	hcs	ESF	none	internal	off	Lt110	unassigned
4C4	no	0x1a0	hcs	ESF	none	internal	off	Lt110	unassigned
4C5	no	0x1a0	hcs	ESF	none	internal	off	Lt110	unassigned
4C6	no	0x1a0	hcs	ESF	none	internal	off	Lt110	unassigned

configuration port cesds1 show

Port		Framing	Carrier	Line	Loopback	Port	Line	Line
		Mode	State	Code	State	Timing	Length	Status
2A1	down	ESF	no	B8ZS	none	internal	<130	64
2A2	down	ESF	no	B8ZS	none	internal	<130	64
2A3	down	ESF	no	B8ZS	none	internal	<130	64
2A4	down	ESF	no	B8ZS	none	internal	<130	64
2A5	down	ESF	no	B8ZS	none	internal	<130	64
2A6	down	ESF	no	B8ZS	none	internal	<130	64

configuration port sonet show

Port	Width	Line	Mode	Loopback	Timing	Scrambling	EmptyCells
1C1	sts3c	MM	sonet	none	internal	on	unassigned
1C2	sts3c	MM	sonet	none	internal	on	unassigned
1C3	sts3c	MM	sonet	none	internal	on	unassigned
1C4	sts3c	MM	sonet	none	internal	on	unassigned
1ח1	sts12c	MM	sonet	none	N / A	on	unassioned

configuration el show

Port	Carrier	Status	Mode	LineType	Loopback	Timing	LineLength	EmptyCells
1B1	no	0x262	hcs	CRC	none	internal	Lt110	idle
1B2	no	0×262	hes	CRC	none	internal	T.+110	idle

configuration port cesel show

Port		Framing	Carrier	Line Loopback	Port	Line	Signalling	Line
		Mode	State	Coding State	Timing	Imp.	Mode	Status
3C1	up	CRC	yes	HDB3 none	internal	L 120	none	1
3C2	up	CRC	yes	HDB3 none	internal	L 120	none	1
3C3	down	CRC	yes	HDB3 none	internal	L 120	none	1
3C4	down	CRC	yes	HDB3 none	internal	L 120	none	1
3C5	down	CRC	yes	HDB3 none	internal	L 120	none	1
3C6	down	CRC	yes	HDB3 none	internal	L 120	none	1

configuration port e3 show

Port	Carrier	Status	Mode	Loopback	Timing	${\tt Scrambling}$	EmptyCells
1D1	no	0x58	hcs	none	internal	off	unassigned
1D2	no	0x58	hcs	none	internal	off	unassigned
1D3	no	0x58	hcs	none	internal	off	unassigned
1D4	no	0x58	hcs	none	internal	off	unassigned

configuration port j2 show

Port	LineLength	Loopback	Timing
1B1	short	none	network
1B2	short	none	network
1B3	short	none	network
1B4	short	none	network

APPENDIX B SCP Diagnostics

The tests provided in this section are very specific diagnostics that are only to be run if you have determined that there is a problem with your SCP.

SCP Diagnostics

If you have determined that there is a hardware problem on a switch control processor (SCP), run the SCP diagnostics that are available by connecting a terminal device to that SCP's serial port.



These diagnostics will only test the SCP, not the multiplexer module.



All AMI sessions should be closed before these test are run.



It is recommended that you back up your CDB before running any tests that check the FLASH and/ or the SRAM. The chips are saved before testing each one and then restored. However, if a power failure would occur or if the MSC-900 were rebooted during the test, some of the data may not be restored properly.

B.1.1 Accessing the Monitor Mode

To access the Monitor mode on an i960 SCP to run these tests, perform the following steps:

- 1. Soft boot the SCP by pressing the RESET button on the front panel of the SCP. Because the RESET button was designed to avoid accidental resets, you will need to use a straightened paper clip to push the RESET button.
- 2. Press and hold the SELECT button on the front panel of the SCP. The display LED will cycle through the following parameters:

```
- 12:00 a.m.
- TTY Test
- DRAM 00-15 MB
- DRAM OK
- Timer T
- Clock T
- TEST BUS
- FLASH?
```

- 3. When the display LED shows FLASH?, press the NEXT button. ETHERNT? will be shown on the display LED.
- 4. Press the NEXT button again so that MONITOR? is shown on the display LED.
- 5. Press the SELECT button. The ? will disappear from MONITOR on the display LED, indicating that MONITOR has been chosen. The terminal device will indicate that user is in the SCP Debug Monitor.
- Press the RETURN key on your terminal device's keyboard to get to the => prompt.
- 7. At the => prompt, type ? and press the RETURN key. The following menu will be displayed:

```
Available commands are:
                - help info for optional cmd
he [cmd]
? [cmd]
                - help info for optional cmd
                - print out version header
ve
                - reset board, retaining baud rate
rs
                - reset board and autobaud
do [offset]
                - download using Xmodem
ps [address]
                - single step through program, skipping procedure calls
st [address]
                - single step through program
qo [address]
                - go from start, or continue from breakpoint
fr address#times - display one or more real (32 bit) floating
                   point numbers
```

```
fl address#times - display one or more long real (64 bit)
                  floating point numbers
fx address#times - display one or more extended real (80 bit)
                  floating point numbers
da address#times - disassemble one or more instructions
db address#bytes - display one or more bytes
ds address#shrts - display one or more shorts
di address#words - display one or more words
dd address#times - display one or more sets of double words
dt address#times - display one or more sets of triple words
dq address#times - display one or more sets of quad words
                - dump contents of registers
di rea
                - display the contents of the register 'reg'
mo reg
                - modify a register. Reg can NOT be fp0-fp3,
mo address#words - modify one or more words in memory
                - modify a byte in memory (doesn't read byte first)
fi address address data - fill memory with data value
tr option on/off - turn on or off one of the following trace options
                  branch, call, return or supervisor call
br [address]
                - set instruction break. If no address is given,
                  all current breakpoints are displayed
bd [addr][mode] - set data breakpoint. If no address is given,
                  all current breakpoints are displayed
                  default mode is set to ANY access
de address
                - delete specified instruction or data breakpoint
                - repeat previous command
test-clock
                      - test Real Time Clock
test-dram
                      - test DRAM
test-dl
                      - test DRAM in a longer, more robust test
test-dc <bank> <chip> - test DRAM chip # <chip> in bank <bank>
                     - test DRAM SIMM # <simm>
test-sim <simm>
march-data <addr> - test the integrity of the data bus
march-address <addr> - test the integrity of the address bus
test-ethernet
                      - test Ethernet
test-flash
                      - test Flash
test-fc <chip>
                     - test Flash chip <chip>
test-serial
                      - test Serial Port
                      - test SRAM
test-sram
test-timer
                      - test Timer
test-sdb
                      - test SDB
test-all
                      - test all devices, except Flash and SRAM
test-manufact
                     - test all devices
                      - attempt to boot from the Flash
boot-flash
```

```
boot-ethernet [<file> [<source-ip> [<my-ip>] ]

- attempt to boot from the Ethernet

bcopy <src> <dest> <len-in-bytes>

wbyte <addr> <data> - write lowest byte of data to addr

wshort <addr> <data> - write lowest short of data to addr

wint <addr> <data> - write data to addr

sbyte <addr> - show the value of the byte at addr

sshort <addr> - show the value of the short at addr

sint <addr> - show the value of the int at addr

erase-flash - Erase entire FLASH memory

erase-fc <chip> - Erase FLASH chip <chip>
```

B.1.2 Running the Hardware Tests

This last portion from the displayed list is the group of hardware tests that the user can run on the SCP:

```
test-clock
                    - test Real Time Clock
test-dram
                    - test DRAM
test-dc <bank> <chip> - test DRAM chip # <chip> in bank <bank>
test-ethernet
                   - test Ethernet
test-flash
                    - test Flash
test-fc <chip>
                   - test Flash chip <chip>
test-serial
                   - test Serial Port
test-sram
                    - test SRAM
test-timer
                   - test Timer
test-all
                   - test all devices, except Flash and SRAM
                - test all devices
test-manufact
```

Type the test command at the prompt to run the individual test. A test that completes correctly will be reported as "OK" on both the terminal connected to the serial port and on the display LED on the front panel of the SCP. A test that is not successful will be reported as "failure" on the terminal connected to the serial port and as "BAD" on the display LED. If any of the tests fail, contact FORE Systems' Technical Support.

The following subsections depict an example of how to perform each test through the serial port and the SCP's confirmation message to the terminal connected to the serial port that the test was successful. The user input is in bold courier font and the SCP's response is shown in courier font.

B.1.2.1 Clock Test

This test checks the real time clock to verify that it is ticking correctly. It takes about two seconds to run.

```
=>test-clock
Clock: OK
```

B.1.2.2 DRAM Test

This test checks the DRAM's functionality. It takes about two seconds to run.

```
=>test-dram
DRAM: OK
```

B.1.2.3 DRAM Chip Test

This test checks the functionality of a DRAM chip. It takes about two seconds to run.

```
=>test-dc a DRAM chip: OK
```

B.1.2.4 Ethernet Test

This test checks the functionality of the Ethernet chip. It takes about two seconds to run.

```
=>test-ethernet
Ethernet: OK
```

B.1.2.5 FLASH Test

This test checks the functionality of each FLASH chip. It takes about five minutes to run.



=>test-flash

It is recommended that you back up your CDB before running this test. The chips are saved before testing each one and then restored. However, if a power failure would occur or if the MSC-900 were rebooted during the test, some of the data may not be restored properly.

```
Flash Test
Save Chip 0

Erase Chip
Pattern 0

Erase Chip
Pattern 1

Erase Chip
Pattern 2

Erase Chip
Pattern 3

.
.
.
.
Erase Chip
Pattern 1

Erase Chip
Pattern 2
```

Erase Chip Pattern 3 Flash: OK

B.1.2.6 FLASH Chip Test

This test checks the functionality of an individual FLASH chip. It takes about one and a half minutes to run.



It is recommended that you back up your CDB before running this test. The chip is saved before it is tested and then restored. However, if a power failure would occur or if the MSC-900 were rebooted during the test, some of the data may not be restored properly.

=>test-fc 1
Save Chip 1
Erase Chip
Pattern 0
Erase Chip
Pattern 1
Erase Chip
Pattern 2
Erase Chip
Pattern 3
Flash: OK

B.1.2.7 Serial Port Test

This test checks the serial port's functionality. It takes about two seconds to run.

```
=>test-serial
Serial: OK
```

B.1.2.8 SRAM Test

This test checks the SRAM's functionality. It takes about two seconds to run.



It is recommended that you back up your CDB before running this test. The SRAM is saved before testing and then restored. However, if a power failure would occur or if the MSC-900 were rebooted during the test, some of the data may not be restored properly.

```
=>test-sram
SRAM: OK
```

B.1.2.9 Timer Test

This test checks to see if the timer is counting correctly. It takes about two seconds to run.

```
=>test-timer
Timer: OK
```

B.1.2.10 Hardware Test

This series of tests checks the functionality of all of the hardware devices in the SCP, except the FLASH chips and SRAM. It takes about fifteen seconds to run.

B.1.2.11 Complete Hardware Test

This series of tests checks the functionality of all of the hardware devices, in the SCP including the FLASH chips and SRAM. It takes about six minutes to run.



It is recommended that you back up your CDB before running this test. The chips are saved before testing each one and then restored. However, if a power failure would occur or if the MSC-900 were rebooted during the test, some of the data may not be restored properly.

SCP Diagnostics



Network Module Specifications

Network modules are the physical port interface cards that provide connectivity to other ATM equipment and carrier ATM services. Currently, network modules are available to provide ATM connections ranging from 1.5 Mbps to 622 Mbps over both fiber-optic and copper media.

This appendix details the technical specifications for MSC-900 network modules, all of which are hot-swappable (see Chapter 3 for more information about hot-swappability).

C.1 Access Modules

The network modules in this section are considered access modules (i.e., slower than 155 Mbps), and can be installed in any MSC-900 multiplexer slot.

C.1.1 100 Mbps TAXI Module

The following specifications apply to network modules NM-6/100SCC and NM-6/100STC:

Description	Specification
Port Capacity	Six TAXI ports per module
Data Rate	100 Mbps
Output Buffer	13,312 cell capacity
Media	Multimode fiber
Max. Line Length	~2 km
Connectors	ST or dual SC
Line Encoding	4B/5B
Loopbacks	Transmit and receive loopbacks
Power	-14 to -20 dBm Tx, -14 to -30 dBm Rx, 0 - 10 dB path attenuation
Core Diameter	62.5 μm
Fiber Diameter	125 μm
Wavelength	1310 nm
Statistics	TAXI statistics including Header Check Sequence (HCS) errors
Compliance	ATM Forum TAXI UNI v3.1, ITU-T I.432, ANSI X3T9.5, ISO DIS9314-3

C.1.2 1.5 Mbps DS1 Module

The following specifications apply to network modules NM-2/DS1C and NM-6/DS1C:

Description	Specification
Port Capacity	Two or six DS1 ports per module
Data Rate	1.544 Mbps
Output Buffer	13,312 cell capacity
Media	Unshielded Twisted Pair (UTP)
Max. Line Length	~655 ft
Connector	RJ-45
Line Encoding	B8ZS
Framing	ESF, optionally PLCP
Clock Accuracy	±32 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Impedance	100 ohms nominal
Statistics/Alarms	Line Code Violations (LCV), framing bit errors(FER), CRC-6 Bit Error Events (BEE), Out Of Frame events (OOF), Header Check Sequence (HCS) errors, cells received (RxCells), cells transmitted (TxCells), signal/clock detection, and AIS indication
Compliance	ATM Forum AF-PHY-0016.000, ANSI/Bellcore T1.102, T1.107, T1.408, TR-TSY-000009, ITU-T G.703, G.704, G.804

C.1.3 1.5 Mbps DS1 Circuit Emulation Services Module

The following specifications apply to network module NMCE-6/DS1A:

Description	Specification
Port Capacity	Six CESDS1 ports per module
Data Rate	1.544 Mbps
Output Buffer	13,312 cell capacity
Max. Connections	127
Media	Unshielded Twisted Pair (UTP)
Max. Line Length	~655 ft
Connector	RJ-48c
Circuit Framing	Structured Service: Digital cross-connect emulation where Nx64 Kbps and Nx56 Kbps circuits are mapped to unique ATM Virtual Connections (VCs); N = 1 to 24 contiguous or non-contiguous Digital Signal Level Zero (DS0) channels per CESDS1 port Unstructured Service: Full bandwidth 1.544 Mbps clear channel service per CESDS1 port
Circuit Signalling	Channel Associated Signaling (CAS) and Basic modes supported with Structured Service
Line Encoding	B8ZS or AMI (user-configurable)
Framing	ESF or SF (user-configurable)
Clock Accuracy	±32 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Impedance	100 ohms nominal
Statistics/Alarms	Line Code Violations (LCV), framing bit errors(FER), CRC-6 Bit Error Events (BEE), Out Of Frame events (OOF), Header Check Sequence (HCS) errors, cells received (RxCells), cells transmitted (TxCells), signal/clock detection, and AIS indication
Compliance	ATM Forum 94-0033R8, ANSI/Bellcore T1.102, T1.107, T1.408, TR-TSY-000009, ITU-T G.703, G.704, G.804

C.1.3.1 DS1 Pinout Specifications

DS1 network modules have a standard RJ-45 female connector that uses RJ-48C CPE pinouts as illustrated in the table below:

Pin Number	Signal Mnemonic	Signal Name
1	RX+	Receive Data +
2	RX-	Receive Data -
3		Not Used
4	TX+	Transmit Data +
5	TX-	Transmit Data -
6		Not Used
7		Not Used
8		Not Used

C.1.4 2 Mbps E1 Module

The following specifications apply to network modules NM-2/E1C and NM-6/E1C:

Description	Specification
Port Capacity	Two or six E1 ports per module
Data Rate	2.048 Mbps
Output Buffer	13,312 cell capacity
Media	Unshielded Twisted Pair (UTP)
Max. Line Length	~655 ft
Connector	RJ-48c
Line Encoding	HDB3
Framing	CRC-4 Multiframe
Clock Accuracy	±32 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Impedance	120 ohms nominal
Statistics/Alarms	Line Code Violations (LCV), framing bit errors (FER), Far End Block Errors (FEBE), CRC error events, Header Check Sequence (HCS) errors, cells received (RxCells), cells transmitted (TxCells), signal/clock detection, and AIS indication
Compliance	ATM Forum AF-PHY-94-0422 R5, ITU-T G.703, G.704, G.804, I.432

C.1.5 2 Mbps E1 Circuit Emulation Services Module

The following specifications apply to network modules NMCE-6/E1A:

Description	Specification
Port Capacity	Six CESE1 ports per module
Data Rate	2.048 Mbps
Output Buffer	13,312 cell capacity
Media	Unshielded Twisted Pair (UTP)
Max. Line Length	~655 ft
Connector	RJ-48c
Circuit Framing	Structured Service: Digital cross-connect emulation where Nx64 Kbps and Nx56 Kbps circuits are mapped to unique ATM Virtual Connections (VCs); N = 1 to 31 contiguous or non-contiguous Digital Signal Level Zero (DS0) channels per CESE1 port Unstructured Service: Full bandwidth 2.048 Mbps clear channel service per CESE1 port
Circuit Signalling	Channel Associated Signaling (CAS) and Basic modes supported with Structured Service
Line Encoding	HDB3
Framing	CRC-4, Multiframe, CRC-4 Multiframe
Clock Accuracy	±32 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Per-port line/payload loopback
Impedance	120 ohms nominal
Statistics/Alarms	Line Code Violations (LCV), framing bit errors (FER), Far End Block Errors (FEBE), CRC error events, Header Check Sequence (HCS) errors, cells received (RxCells), cells transmitted (TxCells), signal/clock detection, and AIS indication
Compliance	ATM Forum Circuit Emulation Service Interoperability Specification v2.0 (ATM Forum/95-1504R1), ANSI/Bellcore T1.403, ITU-T G.703, G.704, G.823, G.824

Network Module Specifications

C.1.5.1 E1 Pinout Specifications

E1 network modules have a standard RJ-45 female connector that uses RJ-48C CPE pinouts as illustrated in the table below:

Pin Number	Signal Mnemonic	Signal Name
1	RX+	Receive Data +
2	RX-	Receive Data -
3		Not Used
4	TX+	Transmit Data +
5	TX-	Transmit Data -
6		Not Used
7		Not Used
8		Not Used

C.1.6 6 Mbps J2 Module

The following specifications apply to network module NM-4/J2C:

Description	Specification
Port Capacity	Four J2 ports per module
Data Rate	6.312 Mbps
Output Buffer	13,312 cell capacity
Media	Coaxial
Max. Line Length	~1300 ft
Connector	BNC
Line Encoding	B8ZS
Framing	Per ITU-T G.704
Clock Accuracy	±30 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Impedance	75 ohms nominal
Statistics/Alarms	Line Code Violations (LCV), framing bit errors (FER), CRC error events, Header Check Sequence (HCS) errors, cells received (RxCells), cells transmitted (TxCells), signal/clock detection, and AIS indication
Compliance	ATM Forum AF-PHY-0029.000, NTT Technical Reference of Cell Relay Interface v1, ITU-T G.703, G.704, G.804

Network M

C.1.7 25 Mbps TP25 Module

The following specifications apply to network module NM-6/25UTPEC:

Description	Specification
Port Capacity	Six TP25 ports per module
Data Rate	25.6 Mbps
Output Buffer	2,560 cell capacity
Media	Cat. 3, 4, or 5 Unshielded Twisted Pair (UTP)
Max. Line Length	100 m
Connector	RJ-45
Line Encoding	4B/5B with NRZI
Clock Accuracy	±100 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Receive loopback
Impedance	100 ohms
Statistics/Alarms	Header Check Sequence (HCS) errors, cells received (RxCells), cells transmitted (TxCells), and symbol errors
Compliance	ATM Forum 25.6 Mbps specification AF-PHY-0040.000

C.1.7.1 Connecting Devices with TP25 Network Modules

The TP25 network modules have a standard RJ45 connector that uses pins 1, 2, 7 and 8. When connecting devices using TP25 network modules, you will need to use a UTP crossover cable with the following specification:

- Pin 1 to pin 7 in both directions.
- Pin 2 to pin 8 in both directions.

TP25	Pin	Pin	TP25
RX+	1 🔨	_/ 1	RX+
RX-	2	//2	RX-
	3 \\	// 3	
	4	4	
	5	5	
	6 //	\\ 6	
TX+	7//	\ 7	TX+
TX-	8 /	\ 8	TX-

C.1.7.2 Connecting Devices with Token Ring Pinouts to the MSC-900

Although the MSC-900 uses the 1, 2, 7 and 8 pin assignment recommended by the ATM Forum, some devices use pins 3, 4, 5 and 6. Connecting one of these devices to an MSC-900 would require the connections to be mapped as follows:

- Pin 3 to pin 7 in both directions.
- Pin 4 to pin 1 in both directions.
- Pin 5 to pin 2 in both directions.
- Pin 6 to pin 8 in both directions.

Alternative device	Pin	Pin	TP25
	1	/1	RX+
	2	//2	RX-
RX+	3 🔍	3	
TX+	4	4	
TX-	5	5	
RX-	6	6	
	7	7	TX+
	8	8	TX-

C.1.7.3 Connecting Adapters with Token Ring Pinouts to the MSC-900

Some adapters use different pin assignments than those mentioned before. Connecting one of these adapters to an MSC-900 would require the connections to be mapped as follows:

- Pin 3 to pin 1 in both directions.
- Pin 4 to pin 7 in both directions.
- Pin 5 to pin 8 in both directions.
- Pin 6 to pin 2 in both directions.

Alternative	Pin	Pin	TP25
adapter	1	_1	RX+
	2	//2	RX-
TX+	3	3	
RX+	4 _	4	
RX-	5 💉	5	
TX-	6	6	
	7	7	TX+
	8	8	TX-



The cable used in the connections shown in Section C.1.7.2 and Section C.1.7.3 must be either a UTP-3 or UTP-5 bidirectional crossover cable, with 8-pin male RJ-45 modular connectors at each end.

C.1.8 34 Mbps E3 Module

The following specifications apply to network modules NM-2/E3C and NM-4/E3C:

Description	Specification
Port Capacity	Two or four E3 ports per module
Data Rate	34.368 Mbps
Output Buffer	13,312 cell capacity
Media	Coaxial
Max. Line Length	~450 ft
Connector	BNC
Line Encoding	HDB3
Framing	Per ITU-T G.832 or G.751
Clock Accuracy	±20 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Impedance	75 ohms nominal
Statistics/Alarms	Line code violations (LCV), framing bit errors (FER), P-bit and C-bit errors, header check sequence (HCS) errors, cells received (RxCells), cells transmitted (TxCells), signal/clock detection, code violations, bit errors, parity errors, and AIS indication
Compliance	ATM Forum AF-PHY-94-0406 R5, ITU-T G.703, G.751, G.832, G.804

C.1.9 45 Mbps DS3 Module

The following specifications apply to network modules NM-2/DS3C and NM-4/DS3C:

Description	Specification
Port Capacity	Two or four DS3 ports per module
Data Rate	44.736 Mbps
Output Buffer	13,312 cell capacity
Media	Coaxial
Max. Line Length	~450 ft
Connector	BNC
Line Encoding	B3ZS
Framing	C-bit parity or clear channel, optionally PLCP
Clock Accuracy	±20 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Impedance	75 ohms nominal
Statistics/Alarms	Line code violations (LCV), framing bit errors (FER), P-bit and C-bit errors, header check sequence (HCS) errors, cells received (RxCells), cells transmitted (TxCells), signal/clock detection, and AIS indication
Compliance	ATM Forum DS3 UNI v3.1, ANSI/Bellcore T1.102, T1.107, TR-TSY-000009

C.2 Uplink Modules

The network modules in this section are considered uplink modules (i.e., 155 Mbps or faster), and can only be installed in MSC-900 multiplexer slots 1A, 1B, and 4C.

C.2.1 155 Mbps OC-3c/STM-1 MM Module

The following specifications apply to network modules NM-4/155MMSCC and NM-4/155MMSTC:

Description	Specification
Port Capacity	Four SONET/SDH ports per module
Data Rate	155.52 Mbps
Output Buffer	32,768 cell capacity
Media	Multimode fiber
Max. Line Length	~2 km
Connectors	ST or dual SC
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-3c/STM-1
Clock Accuracy	±20 ppm
Timing	Internal timing or per port network timing
Loopbacks	Transmit and receive loopbacks
Power	-14 to -20 dBm transmit, -14 to -30 dBm receive, 0 to 10 dB path attenuation
Core Diameter	62.5 μm
Fiber Diameter	125 μm
Wavelength	1310 nm
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Yellow Alarm, Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence (HCS) errors
Compliance	ATM Forum STS-3c UNI v3.1, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ITU-T G.957, Bellcore TR-NWT-000253

C.2.2 155 Mbps STS-3c/STM-1 UTP Module

The following specifications apply to network modules NM-4/155UTP5EC and NM-4/155UTP5C:

Description	Specification
Port Capacity	Four SONET/SDH ports per module
Data Rate	155.52 Mbps
Output Buffer	2,560 or 32,768 cell capacity
Media	Category 5 Unshielded Twisted Pair (UTP)
Max. Line Length	100 m
Connectors	RJ-45
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-3c/STM-1
Clock Accuracy	±20 ppm
Timing	Internal timing or per port network timing
Loopbacks	Transmit and receive loopbacks
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Yellow Alarm, Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence (HCS) errors
Compliance	ATM Forum STS-3c UNI v3.1, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ATM Forum AF-PHY-0015.000

C.2.2.1 155 Mbps UTP Pinout Specifications

155 Mbps UTP network modules have a standard RJ-45 female connector and use RJ-45 network equipment pinouts as illustrated in the table below:

Pin Number	Signal Mnemonic	Signal Name
1	RX+	Receive Data +
2	RX-	Receive Data -
3		Not Used
4		Not Used
5		Not Used
6		Not Used
7	TX+	Transmit Data +
8	TX-	Transmit Data -

C.2.2.2 Connecting Devices with 155 Mbps UTP Network Modules

When connecting devices using 155 Mbps UTP network modules, you need to use a category 5 UTP crossover cable with the following specifications:

- Pin 1 to pin 7 in both directions.
- Pin 2 to pin 8 in both directions.

155 Mbps UTP F	Pin Pin	155 Mbps UTP
	1 2 2 3 4 4 5 5 6 6 7 8 8	RX+ RX- TX+ TX-

C.2.3 622 Mbps OC-12c/STM-4c MM Module

The following specifications apply to network module NM-1/622MMSCC:

Description	Specification
Port Capacity	One SONET/SDH port per module
Data Rate	622.08 Mbps
Output Buffer	65,536 cell capacity
Media	Multimode fiber
Max. Line Length	300 m
Connectors	SC
Line encoding	Non-Return to Zero (NRZ)
Framing	STS-12c/STM-4c
Clock Accuracy	±20 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Power	-20 to -14 dBm transmit power, -26 to -14 dBm receive sensitivity, 0 to 6 dB path attenuation for 62.5 μ m fiber, 0 to 2 dB path attenuation for 50 μ m fiber
Core Diameter	62.5 μm, 50 μm
Fiber Diameter	125 μm
Wavelength	1270 - 1380 nm
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Yellow Alarm, Bit Interleaved Parity (Line BIP-24, Section BIP-8, Path BIP-8) errors, Header Check Sequence (HCS) errors, cells received (RxCells), cells transmitted (TxCells)
Compliance	ATM Forum AF-PHY-0046.000, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ITU-T G.957, Bellcore TR-NWT-000253

C.2.4 155 Mbps OC-3c/STM-1 SM Module

The following specifications apply to network modules NM-4/155SMSRC and NM-4/155SMLRC:

Description	Specification	
Port Capacity	Four SONET/SDH ports per module	
Data Rate	155.52 Mbps	
Output Buffer	32,768 cell capacity	
Media	Short or long reach single mode fiber	
Max. Line Length	~2 km (short reach); ~40 km (long reach)	
Connectors	FC	
Line Encoding	Non-Return to Zero (NRZ)	
Framing	STS-3c/STM-1	
Clock Accuracy	±20 ppm	
Timing	Primary and secondary 8kHz reference from internal (default) or network	
Loopbacks	Transmit and receive loopbacks	
Power - Short Reach	-8 to -15 dBm transmit power, -8 to -23 dBm receive sensitivity, 0 to 8 dB path attenuation	
Power - Long Reach	0 to -5 dBm transmit power, -10 to -34 dBm receive sensitivity, 10 to 29 dB path attenuation	
Core Diameter	10 μm	
Fiber Diameter	125 μm	
Wavelength	1310 nm	
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Yellow Alarm, Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence errors (HCS)	
Compliance	ATM Forum STS-3c UNI v3.1, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ITU-T G.957, Bellcore TR-NWT-000253	

C.2.5 155 Mbps OC-3c/STM-1 3MM/1SM Module

The 155 Mbps OC-3c/STM-1 3MM/1SM network module contains one SONET/SDH single mode port (port 4) and three SONET/SDH multimode ports (ports 1, 2, and 3) per module.

The following specifications apply to port 4 on network modules NM-4/155SR3SCC and NM-4/155LR3SCC:

Description	Specification	
Data Rate	155.52 Mbps	
Output Buffer	32,768 cell capacity	
Media	Short or long reach single mode fiber	
Max. Line Length	~2 km (short reach); ~40km (long reach)	
Connectors	FC	
Line Encoding	Non-Return to Zero (NRZ)	
Framing	STS-3c/STM-1	
Clock Accuracy	±20 ppm	
Timing	Primary and secondary 8kHz reference from internal (default) or network	
Loopbacks	Transmit and receive loopbacks	
Power - Short Reach	-8 to -15 dBm transmit power, -8 to -23 dBm receive sensitivity, 0 to 8 dB path attenuation	
Power - Long Reach	0 to -5 dBm transmit power, -10 to -34 dBm receive sensitivity, 10 to 29 dBm path attenuation	
Core Diameter	10 μm	
Fiber Diameter	125 μm	
Wavelength	1310 nm	
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Yellow Alarm, Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence errors (HCS)	
Compliance	ATM Forum STS-3c UNI v3.1, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ITU-T G.957, Bellcore TR-NWT-000253	

The following specifications apply to ports 1, 2, and 3 on network modules NM-4/155SR3SCC and NM-4/155LR3SCC:

Description	Specification
Data Rate	155.52 Mbps
Output Buffer	32,768 cell capacity
Media	Multimode fiber
Max. Line Length	~2 km
Connectors	SC
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-3c/STM-1
Clock Accuracy	±20 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Power	-14 to -20 dBm transmit power, -14 to -30 dBm receive sensitivity, 0 to 10 dB path attenuation
Core Diameter	62.5 μm
Fiber Diameter	125 μm
Wavelength	1310 nm
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Yellow Alarm, Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence errors (HCS)
Compliance	ATM Forum STS-3c UNI v3.1, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ITU-T G.957, Bellcore TR-NWT-000253

C.2.6 622 Mbps OC-12c/STM-4c SM Module

The following specifications apply to network module NM-1/622SMIRC:

Description	Specification
Port Capacity	One SONET/SDH port per module
Data Rate	622.08 Mbps
Output Buffer	65,536 cell capacity
Media	Single mode fiber
Max. Line Length	~14 km
Connectors	FC
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-12c/STM-4c
Clock Accuracy	±20 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Power	-8 to -15 dBm transmit power, -8 to -28 dBm receive sensitivity, 0 to 13 dB path attenuation
Core Diameter	10 μm
Fiber Diameter	125 μm
Wavelength	1310 nm
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Yellow Alarm, Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence errors (HCS), cells received (RxCells), cells transmitted (TxCells)
Compliance	ATM Forum STS-12c UNI v3.1, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ITU-T G.957, Bellcore TR-NWT-000253

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